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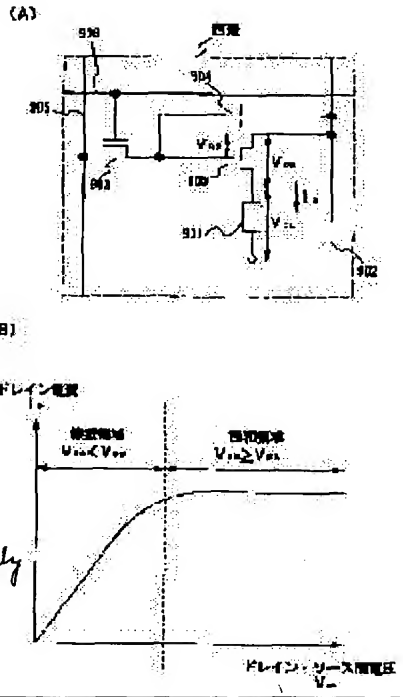
(54) DRIVE METHOD FOR DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To suppress variance in luminance display caused by the characteristic dispersion of TFTs(Thin Film Transistors) constituting pixcels and changes in environmental temperature at which the active matrix type EL(Electroluminescence) display device is used.
SOLUTION: A time gradation system is used. By operating an EL driving TFT in an ON condition and in a saturation region, the drain current of the TFT is held at a constant value. Thus, a constant current flows in an EL element and the active matrix type EL display device having an accurate gradation display with high image quality is realized.



Paragraphs [0202]-[0220] and Fig. 16 are particularly related to this application.

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* NOTICES *

CLAIMS

[Claim(s)]

[Claim 1] Have the pixel which has an EL element and a transistor, respectively, divide an one-frame period during [two or more] the subframe, and it sets during [two or more / each] the aforementioned subframe. If the 1st gate voltage or the 2nd gate voltage is impressed to the gate electrode of the aforementioned transistor and the 1st gate voltage of the above is impressed to the gate electrode of the aforementioned transistor If the drain current of the aforementioned transistor flows between the two electrodes of the aforementioned EL element, the aforementioned EL element will be in a luminescence state and the 2nd gate voltage of the above is impressed to the gate electrode of the aforementioned transistor It is the drive method of the display characterized by for the aforementioned EL element being the drive method of the display which will be in the state where light is not emitted, and the absolute value of the 1st gate voltage of the above being below an absolute value of the voltage between the drain sources of the aforementioned transistor by the aforementioned transistor being in non-switch-on.

[Claim 2] Have the pixel which has an EL element, a transistor, and resistance, respectively, divide an one-frame period during [two or more] the subframe, and it sets during [two or more / each] the aforementioned subframe. If the 1st gate voltage or the 2nd gate voltage is impressed to the gate electrode of the aforementioned transistor and the 1st gate voltage of the above is impressed to the gate electrode of the aforementioned transistor If the drain current of the aforementioned transistor flows between the two electrodes of the aforementioned resistance and the aforementioned EL element, the aforementioned EL element will be in a luminescence state and the 2nd gate voltage of the above is impressed to the gate electrode of the aforementioned transistor It is the drive method of the display characterized by for the aforementioned EL element being the drive method of the display which will be in the state where light is not emitted, and the absolute value of the 1st gate voltage of the above being below an absolute value of the voltage between the drain sources of the aforementioned transistor by the aforementioned transistor being in non-switch-on.

[Claim 3] The drive method of the display characterized by the large thing the more in a claim 1 or a claim 2 in the range in which the absolute value of the 1st gate voltage of the above impressed to the gate electrode of the aforementioned transistor does not exceed the absolute value of the voltage between the drain sources of the aforementioned transistor the more the ratio to the gate length of gate width of the aforementioned transistor is smaller than 1.

[Claim 4] It is the drive method of the display characterized by making color display possible combining a color conversion layer using EL layer in which the aforementioned EL element carries out monochrome luminescence in any 1 term of a claim 1 or a claim 3.

[Claim 5] It is the drive method of the display characterized by making color display possible combining a light filter using EL layer which carries out white luminescence of the aforementioned EL element in any 1 term of a claim 1 or a claim 3.

[Claim 6] It is the drive method of the display characterized by EL layer of the aforementioned EL element being a low-molecular system organic substance or a polymer system organic substance in any 1 term of a claim 1 or a claim 5.

[Claim 7] It is the drive method of display that the aforementioned low-molecular system organic substance is characterized by the bird clapper from Alq3 (tris-8-kino rewrite-aluminum) or TPD (triphenylamine derivative) in a claim 6.
[Claim 8] It is the drive method of display that the aforementioned polymer system organic substance is characterized by the bird clapper from PPV (polyphenylene vinylene), PVK (polyvinyl carbazole), or a polycarbonate in a claim 6.
[Claim 9] It is the drive method of the display characterized by EL layer of the aforementioned EL element being a mineral matter in any 1 term of a claim 1 or a claim 5.
[Claim 10] The video camera characterized by using the drive method of the aforementioned display a publication for any 1 term of a claim 1 or a claim 9, a picture reproducer, a head mount display, a cellular phone, or a Personal Digital Assistant.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the drive method of the electronic display which made EL (electroluminescence) element on the substrate and was formed. It is related with the drive method of EL display especially using the semiconductor device (element using the semiconductor thin film). Moreover, it is related with the electronic equipment which used EL display for the display.
[0002] In addition, in this specification, although an EL element uses luminescence (phosphorescence) from a triplet exciton, it shall indicate both to be the things using luminescence (fluorescence) from a singlet exciton.
[0003]
[Description of the Prior Art] In recent years, development of EL display with the EL element is activating as a spontaneous light type element. EL display is also called the organic EL display (OELD:Organic EL Display) or organic light emitting diode (OLED:Organic Light EmittingDiode).
[0004] Unlike a liquid crystal display, EL display is a spontaneous light type. Although the EL element has the structure where EL layer was pinched between the electrodes (an anode plate and cathode) of a couple, EL layer usually has a laminated structure. Typically, the laminated structure "the electron hole transporting bed / luminous layer / electronic transporting bed" which Tang and others of KODAKKU Eastman Company proposed is mentioned. This structure has very high luminous efficiency, and most EL display with which research and development are furthered has adopted this structure now.
[0005] Moreover, otherwise, the structure which carries out a laminating to the order of a hole-injection layer / electron hole transporting bed / luminous layer / electronic transporting bed on an anode plate, or the structure which carries out a laminating to the order of a hole-injection layer / electron hole transporting bed / luminous layer / electronic transporting bed / electron-injection layer is sufficient. You may dope fluorescence nature coloring matter etc. to a luminous layer.
[0006] All the layers prepared between cathode and an anode plate in this specification are named generically, and it is called EL layer. Therefore, all of the hole-injection layer mentioned above, an electron hole transporting bed, a luminous layer, an electronic transporting bed, an electron-injection layer, etc. are contained in EL layer.
[0007] And predetermined voltage is applied to EL layer which becomes with the above-mentioned structure between the electrodes (two electrodes) of a couple, and thereby, in a luminous layer, the reunion of a carrier happens and light is emitted. In addition, if an EL element drives that an EL element emits light in this specification, it will be called.
[0008] Active-matrix type EL display is mentioned as the drive method of EL display.
[0009] The example of the composition of the pixel section of active-matrix type EL display is shown in drawing 3 . The gate signal line (G1-Gy) which inputs a selection signal from a gate signal line drive circuit is connected to the gate electrode of TFT301 for switching which each pixel has. Moreover, the source field and drain field of TFT301 for switching which each pixel has are connected to one electrode of the capacitor 303 which the gate electrode and each

pixel of TFT302 for EL drive have [another side] at the source signal line (S1-Sx) into which one side inputs a signal from a source signal-line drive circuit. Another electrode of a capacitor 303 is connected to the current supply line (V1-Vx). It connects with one electrode of EL element 304 to which, as for one side of the source field of TFT302 for EL drive, and a drain field which each pixel has, each pixel has another side on a current supply line (V1-Vx).
[0010] EL element 304 has EL layer prepared between an anode plate, cathode, and an anode plate and cathode. When the anode plate of EL element 304 has connected with the source field of TFT302 for EL drive, or a drain field, the anode plate of EL element 304 turns into a pixel electrode, and cathode turns into a counterelectrode. On the contrary, when the cathode of EL element 304 has connected with the source field of TFT302 for EL drive, or a drain field, the cathode of EL element 304 turns into a pixel electrode, and an anode plate turns into a counterelectrode.
[0011] In addition, in this specification, the potential of a counterelectrode is called opposite potential. In addition, the power supply which gives opposite potential to a counterelectrode is called opposite power supply. The potential difference of the potential of a pixel electrode and the potential of a counterelectrode is EL driver voltage, and this EL driver voltage is impressed to EL layer.
[0012] As the gradation method of presentation of the above-mentioned EL display, an analog gradation method and a time gradation method are held.
[0013] First, the analog gradation method of EL display is explained. The timing chart at the time of driving the display shown by drawing 3 by the analog gradation method is shown in drawing 4 . A period after one gate signal line is chosen until the following gate signal line is chosen is called one-line period (L). Moreover, a period after one picture is chosen until the following picture is chosen is equivalent to an one-frame period. Since there are y gate signal lines in the case of EL display of drawing 3 , y line periods (L1-Ly) are prepared during one frame.
[0014] The number of the line periods in an one-frame period also increases, and it must stop having to drive a drive circuit on high frequency as resolution becomes high.
[0015] The current supply line (V1-Vx) is maintained at fixed potential (power supply potential). Moreover, opposite potential is also kept constant. Opposite potential has the potential difference between power supply potentials in the grade to which an EL element emits light.
[0016] In the 1st line period (L1), the selection signal from a gate signal line drive circuit is inputted into the gate signal line G1. And the video signal of an analog is inputted into a source signal line (S1-Sx) in order.
[0017] Since all TFT301 for switching connected to the gate signal line G1 will be in the state of ON, the video signal of the analog inputted into the source signal line (S1-Sx) is inputted into the gate electrode of TFT302 for EL drive through TFT301 for switching.
[0018] TFT301 for switching is turned on and the gate voltage of TFT302 for EL drive changes with the potentials of the video signal of the analog inputted in the pixel. At this time, drain current is decided by 1 to 1 to a gate voltage according to the Id-Vg property of TFT302 for EL drive. That is, corresponding to the potential of the video signal of the analog inputted into the gate electrode of TFT302 for EL drive, the potential (EL drive potential of ON) of a drain field becomes settled, predetermined drain current flows to an EL element, and the aforementioned EL element emits light in the amount of luminescence corresponding to the amount of current.
[0019] After repeating operation mentioned above and completing the input of the video signal of the analog to a source signal line (S1-Sx), the 1st line period (L1) expires. In addition, it is good also considering a period and a horizontal-retrace-line period until the input of the video signal of the analog to a source signal line (S1-Sx) is completed as one line period in all. And next the 2nd line period (L2) comes, and a selection signal is inputted into the gate signal line G2. And the video signal of an analog is inputted into a source signal line (S1-Sx) in order like the 1st line period (L1).
[0020] And if a selection signal is inputted into all gate signal lines (G1-Gy), all line periods

(L1-Ly) will expire. An end of all line periods (L1-Ly) terminates an one-frame period. All pixels display during one frame and one picture is formed. In addition, it is good also considering all line periods (L1-Ly) and vertical-retrace-line periods as an one-frame period in all.

[0021] As mentioned above, the amount of luminescence of an EL element is controlled by the video signal of an analog, and a gradation display is made by control of the amount of luminescence. Thus, a gradation display is performed by the analog gradation method by change of the potential of the video signal of the analog inputted into a source signal line.

[0022] Next, a time gradation method is explained.

[0023] By the time gradation method, a digital signal is inputted into a pixel, the luminescence state or the state where light is not emitted of an EL element is chosen, and the accumulating totals of the period when the EL element emitted light to around the one-frame period express gradation.

[0024] Here, when expressing 2n (n is the natural number) gradation, it attaches and explains. The timing chart at the time of driving the display shown by drawing 3 by this time gradation method is shown in drawing 5 . First, an one-frame period is divided during [n] the subframe (SF1-SFn). In addition, all the pixels of the pixel section call the period which displays one picture one-frame period (F). Moreover, the period which divided the one-frame period into plurality further is called subframe period. The number of partitions of an one-frame period must also increase as the number of gradation increases, and you have to drive a drive circuit on high frequency.

[0025] One subframe period is divided into a write-in period (Ta) and a display period (Ts). A write-in period is a period which inputs a digital signal into all pixels during the 1 subframe, with the inputted digital signal, an EL element will be in luminescence or the state where light is not emitted, and the display period (it is also called a lighting period) shows the period which displays.

[0026] Moreover, EL driver voltage shown in drawing 5 expresses EL driver voltage of the EL element which had the luminescence state chosen. That is, EL driver voltage (drawing 5) of the EL element which had the luminescence state chosen is set to 0V during a write-in period, and it has the size which is the grade to which an EL element emits light during a display period.

[0027] Opposite potential is controlled by the external switch (not shown), and opposite potential is maintained at the almost same height as power supply potential in a write-in period, and has the potential difference which is the grade to which an EL element emits light between power supply potentials in a display period.

[0028] First, the write-in period and display period which each subframe period has are explained in detail using drawing 3 and drawing 5 , and a time gradation display is explained after that.

[0029] A gate signal is first inputted into the gate signal line G1, and all TFT301 for switching connected to the gate signal line G1 will be in the state of ON. And a digital signal is inputted into a source signal line (S1-Sx) in order. Opposite potential is maintained at the same height as the potential (power supply potential) of a current supply line (V1-Vx). The digital signal has the information on "0" or "1." The digital signal of "0" and "1" means the signal which has the voltage of either Hi or Lo, respectively.

[0030] And the digital signal inputted into the source signal line (S1-Sx) is inputted into the gate electrode of TFT302 for EL drive through TFT301 for switching of the state of ON. Moreover, a digital signal is inputted also into a capacitor 303 and it is held.

[0031] And the digital signal which operation mentioned above in inputting a gate signal into the gate signal lines G2-Gy in order was repeated, and the digital signal was inputted into all pixels, and was inputted in each pixel is held. A period until a digital signal is inputted into all pixels is written in, and it is called a period.

[0032] If a digital signal is inputted into all pixels, all TFT301 for switching will be in the state of OFF. And opposite potential changes with the external switches (not shown) connected to the counterelectrode so that it may have the potential difference which is the grade to which

EL element 304 emits light between power supply potentials.
[0033] When the digital signal has the information on "0", TFT302 for EL drive will be in the state of OFF, and EL element 304 will not emit light. On the contrary, when it has the information on "1", TFT302 for EL drive will be in the state of ON. As a result, the pixel electrode of EL element 304 is kept almost equal to power supply potential, and EL element 304 emits light. Thus, the luminescence state or the state where light is not emitted of an EL element is chosen by the information which a digital signal has, and all pixels display all at once using it. A picture is formed when all pixels display. The period when a pixel displays is called display period.
[0034] All the length of the write-in period (Ta1-Tan) which it has, respectively has n the same subframe periods (SF1-SFn). SF1-SFn set to Ts1-Tsn the display period (Ts) which it has, respectively, respectively.
[0035] The length of a display period is [-- It sets up so that it may become :2-(n-2):2- (n-1).] Ts1:Ts2:Ts3. : -- It is :Ts(n-1):Tsn=20:2-1:2-2. : A desired gradation display can be performed among 2n gradation in the combination of this display period.
[0036] Display periods are one to Ts1-Tsn of periods. Here, it carries out to having made the predetermined pixel of Ts1 turn on during the period.
[0037] Next, it enters again in a write-in period, and if a data signal is inputted into all pixels, it will enter during the display. At this time, the period of either Ts2-Tsn turns into a display period. Here, it carries out to having made the predetermined pixel of Ts2 turn on during the period.
[0038] The operation same about the n-2 remaining subframes is repeated hereafter, and it is Ts3 and Ts4 one by one. -- Tsn and a display period are set up and it carries out to having made the pixel predetermined by each subframe turn on.
[0039] When n subframe periods appear, it means finishing an one-frame period. At this time, the gradation of the pixel is decided by integrating the length of the display period which the pixel had turned on. For example, when brightness when a pixel emits light in all display periods was made into 100% at the time of n= 8 and a pixel emits light in Ts1 and Ts2, 75% of brightness can be expressed, and when Ts3, and Ts5 and Ts8 are chosen, 16% of brightness can be expressed.
[0040] In addition, in the drive method of a time [to input a n-bit digital signal and express gradation] gradation method, the length of the number of partitions or each subframe period at the time of dividing an one-frame period during [two or more] the subframe etc. is not limited above.
[0041]
[Problem(s) to be Solved by the Invention] The trouble in the case of using the analog gradation method shown in the conventional example is listed to a degree.
[0042] By the analog gradation method, there is a trouble that the variation in the property of TFT influences a gradation display greatly. For example, the case where it differs by two pixels as which the Id-Vg property of TFT for switching expresses the same gradation is assumed (when the property of one of pixels shifts to a plus or minus side on the whole to another side).
[0043] In this case, the drain current of each TFT for switching serves as a different value, and the gate voltage of a different value will be impressed to TFT for EL drive of each pixel. The current of a different amount to each EL element flows, it becomes the different amount of luminescence as a result, and it becomes impossible that is, to express the same gradation.

[0044] Moreover, though a gate voltage equal to TFT for EL drive of each pixel is impressed, if variation is in the Id-Vg property of TFT for EL drive, the same drain current cannot be outputted. Therefore, if it differs even when Id-Vg properties are few, even if an equal gate voltage is impressed, the situation of differing greatly may produce the amount of current outputted. Then, with variations in few Id-Vg properties, even if it inputs the signal of the same voltage, the amount of luminescence of an EL element will change greatly by the contiguity pixel.

[0045] In fact, since it becomes the synergistic effect of both variation of TFT for switching, and TFT for EL drive, a gradation display will be rose ****** still more greatly. Thus, the analog gradation display is very sensitive to the property variation of TFT. Therefore, when this EL display performs a gradation display, that the display has much nonuniformity poses a problem.
[0046] Next, the trouble in the case of using a time gradation method is mentioned.
[0047] The brightness of an EL element is expressed by the time gradation method by the time when current was flowing and emitting light to the EL element. Therefore, the display nonuniformity by the property variation of TFT which became a problem in the above-mentioned analog gradation method is stopped sharply. However, there is another problem.
[0048] The current which flows to an EL element is controlled by voltage (EL driver voltage) impressed between the two electrodes of an EL element. This EL driver voltage is the voltage which deducted the voltage between the drain sources of TFT for EL drive from the potential difference of power supply potential and opposite potential. In order to avoid the influence of the variation in the voltage between the drain sources by the variation in the property of TFT for EL drive and to keep this EL driver voltage constant, the voltage between the drain sources of TFT for EL drive is small set up for whether being ** compared with EL driver voltage. At this time, TFT for EL drive is operating in the alignment field.
[0049] In TFT operation, it is equivalent to an active region when the voltage VDS between the drain sources of TFT is smaller than the gate voltage VGS of TFT with a line type field.
[0050] Here, the current which flows between the two electrodes of an EL element is influenced with temperature. Drawing 17 is a graph which shows the temperature characteristic of an EL element. The amount of current which flows between the two electrodes of an EL element with this graph to the voltage impressed between the two electrodes of an EL element to the bottom of a certain temperature can be known. Temperature T1 is higher than temperature T2, and that of temperature T2 is higher than temperature T3. A bird clapper understands between the two electrodes of an EL element for the flowing current greatly, so that it will become high if the temperature of EL layer becomes high by the temperature characteristic which an EL element has even if the voltage impressed between the two electrodes of the EL element of the pixel section is the same.
[0051] Moreover, the brightness of an EL element is proportional to the amount of current which flows between the two electrodes of an EL element.
[0052] Thus, it is a problem that change the current which will flow between the two electrodes of an EL element even if it is continuing applying fixed voltage between the two electrodes of an EL element, brightness changes, and an exact gradation display becomes impossible by change of the environmental temperature which uses EL display.
[0053] In active-matrix type EL display, when using an analog gradation method like before, and a time gradation method, an exact gradation display cannot be performed for the reason mentioned above. Then, the exact gradation display of this invention is enabled, and it makes it a technical problem to offer the drive method of EL display in which a high-definition display is possible.
[0054]
[Means for Solving the Problem] this invention drives active-matrix type EL display with a time gradation method. At this time, TFT for EL drive is operated by the saturation region, and it is characterized by keeping drain current constant to a temperature change.
[0055] The current which flows between the two electrodes of an EL element can be kept constant to the variation in the property of TFT, and change of environmental temperature by this, an exact gradation display is possible and the drive method of EL display in which a high-definition display is possible can be offered.
[0056] The composition of this invention is shown below.
[0057] By this invention, have the pixel which has an EL element and a transistor, respectively, divide an one-frame period during [two or more] the subframe, and it sets during [two or more / each] the aforementioned subframe. If the 1st gate voltage or the 2nd gate voltage is impressed to the gate electrode of the aforementioned transistor and the 1st

gate voltage of the above is impressed to the gate electrode of the aforementioned transistor If the drain current of the aforementioned transistor flows between the two electrodes of the aforementioned EL element, the aforementioned EL element will be in a luminescence state and the 2nd gate voltage of the above is impressed to the gate electrode of the aforementioned transistor The aforementioned transistor will be in non-switch-on, the aforementioned EL element is the drive method of the display which will be in the state where light is not emitted, and the drive method of the display characterized by the absolute value of the 1st gate voltage of the above being below an absolute value of the voltage between the drain sources of the aforementioned transistor is offered.

[0058] By this invention, have the pixel which has an EL element, a transistor, and resistance, respectively, divide an one-frame period during [two or more] the subframe, and it sets during [two or more / each] the aforementioned subframe. If the 1st gate voltage or the 2nd gate voltage is impressed to the gate electrode of the aforementioned transistor and the 1st gate voltage of the above is impressed to the gate electrode of the aforementioned transistor If the drain current of the aforementioned transistor flows between the two electrodes of the aforementioned resistance and the aforementioned EL element, the aforementioned EL element will be in a luminescence state and the 2nd gate voltage of the above is impressed to the gate electrode of the aforementioned transistor The aforementioned transistor will be in non-switch-on, the aforementioned EL element is the drive method of the display which will be in the state where light is not emitted, and the drive method of the display characterized by the absolute value of the 1st gate voltage of the above being below an absolute value of the voltage between the drain sources of the aforementioned transistor is offered.

[0059] The more the ratio to the gate length of gate width of the aforementioned transistor is smaller than 1, the more the absolute value of the 1st gate voltage of the above impressed to the gate electrode of the aforementioned transistor may be the drive method of the display characterized by the large thing in the range which does not exceed the absolute value of the voltage between the drain sources of the aforementioned transistor.

[0060] The aforementioned EL element may be the drive method of the display characterized by making color display possible combining a color conversion layer using EL layer which carries out monochrome luminescence.

[0061] The aforementioned EL element may be the drive method of the display characterized by making color display possible combining a light filter using EL layer which carries out white luminescence.

[0062] EL layer of the aforementioned EL element may be the drive method of the display characterized by being a low-molecular system organic substance or a polymer system organic substance.

[0063] The aforementioned low-molecular system organic substance may be the drive method of the display characterized by the bird clapper from Alq3 (tris-8-kino rewrite-aluminum) or TPD (triphenylamine derivative).

[0064] The aforementioned polymer system organic substance may be the drive method of the display characterized by the bird clapper from PPV (polyphenylene vinylene), PVK (polyvinyl carbazole), or a polycarbonate.

[0065] EL layer of the aforementioned EL element may be the drive method of the display characterized by being a mineral matter.

[0066] You may be the video camera characterized by using the drive method of the aforementioned display, a picture reproducer, a head mount display, a cellular phone, or a Personal Digital Assistant.

[0067]

[Embodiments of the Invention] The gestalt of operation of this invention is explained using drawing 1.

[0068] Drawing 1 (A) shows the composition of the pixel of EL display of this invention. The gate electrode of TFT903 for switching is connected to the gate signal line 906. One side is connected to the source signal line 905, and another side is connected to the gate electrode and capacitor 904 of TFT900 for EL drive for the source field and drain field of TFT903 for

switching. One side is connected to the current supply line 902, and another side is connected to the anode plate or cathode of EL element 901 for the source field and drain field of TFT900 for EL drive.

[0069] Voltage (gate voltage) impressed between the gate sources of TFT900 for EL drive from TFT903 for switching is set to VGS. Moreover, voltage (voltage between the drain sources) given between the drain sources of TFT900 for EL drive is set to VDS, and the current (drain current) which flows between the drain sources at this time is set to ID. This drain current ID is inputted into EL element 901. Moreover, if voltage (EL driver voltage) impressed between the two electrodes of EL element 901 is set to VEL, the voltage VIN impressed to the pixel section (counterelectrode of an EL element) from the current supply line 902 will be given by the sum of the voltage VDS between the drain sources, and the EL driver voltage VEL.

[0070] Here, the relation between the voltage VDS between the drain sources and drain current ID is shown in a graph at drawing 1 (B). The gate voltage VGS is fixed. In this graph, the field where drain current ID corresponds by 1 to 1 to the voltage VDS between the drain sources is called line type field, and the voltage VDS between the drain sources corresponds, when small compared with a gate voltage VGS. Moreover, drain current ID calls the field of simultaneously regularity a saturation region to the voltage VDS between the drain sources. This corresponds, when the voltage VDS between the drain sources is more than gate-voltage VGS.

[0071] It was controlling by the drive method of EL display by the conventional time gradation method so that the voltage impressed between the two electrodes of an EL element became fixed. At this time, the voltage VDS between the drain sources of TFT for EL drive will affect the EL driver voltage VEL with rose **** by the variation in the property of TFT. Then, in order to suppress the influence of this variation as much as possible, the voltage VDS between the drain sources of TFT for EL drive is small set up to the EL driver voltage VEL, and the great portion of voltage VIN inputted into a pixel is made to be impressed between the two electrodes of an EL element. Therefore, TFT for EL drive was operated in the line type field in which the voltage VDS between the drain sources corresponds when small compared with a gate voltage VGS.

[0072] It is made to operate with EL display of this invention by the saturation region which sets up the voltage VDS between the drain sources of TFT900 for EL drive more than gate-voltage VGS, and is not concerned with the voltage VDS between the drain sources in TFT900 for EL drive, but passes fixed drain current ID. By this, it will not be based on a temperature change but fixed current will always be supplied to an EL element.

[0073] The example value of voltage inputted into an EL element and TFT for EL drive is shown below.

[0074] For example, threshold voltage of TFT for EL drive is made into about 2V. Here, in the pixel which had the luminescence state of an EL element chosen, when the gate voltage VGS of TFT for EL drive is set to 5V, voltage between the counterelectrodes of an EL element and current supply lines in a display period (difference of opposite potential and power supply potential) is made into about 15V. At this time, the voltage VEL between the two electrodes of an EL element takes an about [5-10V] value, and the voltage VDS between the drain sources of TFT for EL drive becomes more than 5V. At this time, the voltage VDS between the drain sources of TFT for EL drive becomes more than gate-voltage VGS, and TFT for EL drive operates by the saturation region.

[0075] Thereby, to an EL element, it will not be based on a temperature change, but fixed current will always flow, and light is emitted by fixed brightness to it.

[0076]

[Example] Below, the example of this invention is explained.

[0077] (Example 1) In the technique of keeping constant the current ID which TFT for EL drive stated with the gestalt of implementation of invention is operated by the saturation region, and flows between the two electrodes of an EL element, this example describes how to suppress the influence of the variation in the property of TFT for EL drive. The same sign as

the sign used in drawing 1 (A) and the sign added newly are used for explanation.
[0078] When operating TFT900 for EL drive by the saturation region, the formula 1 shown below is materialized.
[0079]
[Formula 1] ID=alpha (VGS-Vth) 2 (W/L) [0080] For a gate voltage and Vth, in a formula 1, threshold voltage and W are [ID / drain current and VGS / gate length and alpha of gate width and L] constants. Here, since the threshold voltage Vth has variation, drain current ID will have variation.
[0081] then, a ratio [on the range which operates by the saturation region in order to suppress this variation, and as opposed to gate-length L of gate width W] -- W/L is made small and a gate voltage VGS is enlarged Thereby, the variation in the drain current ID by the variation in the threshold voltage Vth of TFT900 for EL drive can be suppressed.
[0082] For example, the threshold voltage Vth takes the value of 2**0.1V, and presupposes that it has 5% of variation. When W/L is set to 8, a gate voltage VGS is set to 3V. When the value of drain current ID is calculated at this time, it will have about 20% of variation. Here, the average of drain current ID presupposes that it is I0. On the other hand, if W/L is set to 0.5, in order to make the average I0 of drain current ID the same as the case where W/L is 8, it is necessary to set a gate voltage VGS to about 6 V. It will be stopped by about 5% of variation if the value of drain current ID is calculated when a gate voltage VGS is 6V.
[0083] Thus, it is good to make W/L or less into 0.5 desirably less than one.
[0084] (Example 2) In the technique of keeping constant the current ID which TFT for EL drive stated with the gestalt of implementation of invention is operated by the saturation region, and flows between the two electrodes of an EL element, by this example, it is the method of being different in an example 1, and how to suppress the influence of the variation in the property of TFT for EL drive is stated.
[0085] The composition of the pixel section of the display of this example is shown in drawing 2 . Since fundamental structure is the same as that of drawing 1 (A), it attaches and explains a sign which is different into a change portion.
[0086] The gate electrode of TFT903 for switching is connected to the gate signal line 906. One side is connected to the source signal line 905, and another side is connected to the gate electrode of TFT900 for EL drive, and one electrode of a capacitor 904 for the source field and drain field of TFT903 for switching. Another electrode of a capacitor 904 is connected to the current supply line 902. One side is connected to the current supply line 902 through resistance 907, and another side is connected to the anode plate or cathode of EL element 901 for the source field and drain field of TFT900 for EL drive.
[0087] In the composition of the pixel of this example, the formula 1 shown in the example 1 and the formula 2 shown below are materialized simultaneously.
[0088]
[Formula 2] V=VGS+RID [0089] Here, V is the potential difference given between the gate electrode of TFT900 for EL drive, and the current supply line 902. Moreover, R is the resistance of resistance 907.
[0090] By the formula 1 and the formula 2, the gate voltage VGS and the drain current ID at the time of allotting resistance 907, as shown in drawing 2 are searched for. At this time, it calculates with [to the variation in the threshold voltage Vth / of drain current ID] a rose.
[0091] For example, in a formula 1 and a formula 2, alpha is made into 2x10-6 F/V-s, and W/L is set to 1. Here, Vth takes the value of 2**0.1V and presupposes that it has 5% of variation.
[0092] First, R considers the case of 0 (when there is no resistance 907). V is set to 4V. A gate voltage VGS is set to 4V in accordance with V. The variation in the drain current at this time is about 10%. At this time, the average of drain current is abbreviation 8x10-6A.
[0093] Next, R considers the case of 1x106 ohms. V is set to 12V in order to maintain the average of drain current at abbreviation 8x10-6A. At this time, the variation in the drain current ID which receives with [of the threshold voltage Vth] a rose is suppressed to about 1%.
[0094] Shortly, R considers the case of 2x106 ohms. In order to maintain the average of drain

current at abbreviation 8x10-6A, V is set to 20V. At this time, the variation in the drain current ID which receives with [of the threshold voltage Vth] a rose is suppressed to about 0.6%.

[0095] Thus, the variation in the drain current ID which receives with [of the threshold voltage Vth] a rose can be suppressed by allotting 907 for resistance and taking the large resistance.

[0096] It combines with an example 1 freely and this example can be carried out.

[0097] (Example 3) this example explains how to produce simultaneously TFT of the pixel section of the display which uses the drive method of this invention, and the drive circuit section (a source signal-line side drive circuit, gate signal line side drive circuit) prepared around it. However, in order to simplify explanation, suppose that the CMOS circuit which is a base unit is illustrated about the drive circuit section.

[0098] First, as shown in drawing 8 (A), the ground film 5002 which consists of insulator layers, such as a silicon-oxide film, a silicon nitride film, or an oxidization silicon nitride film, is formed on the substrate 5001 which consists of glass, such as barium borosilicate glass represented by #7059 glass of Corning, Inc., #1737 glass, etc., or alumino borosilicate glass. For example, 10-200 [nm] (preferably 50-100 [nm]) formation of SiH4, NH3, and the oxidization silicon-nitride-film 5002a produced from N2O is carried out by the plasma CVD method, and laminating formation of the oxidization nitriding hydrogenation silicon film 5002b similarly produced from SiH4 and N2O is carried out at the thickness of 50-200 [nm] (preferably 100-150 [nm]). Although this example showed the ground film 5002 as two-layer structure, you may form as structure which carried out the laminating the monolayer of the aforementioned insulator layer, or more than two-layer.

[0099] The island-like semiconductor layers 5003-5006 are formed by the crystalline-substance semiconductor film which produced the semiconductor film which has amorphous structure using the laser crystallizing method or the well-known heat crystallizing method. The thickness of these island-like semiconductor layers 5003-5006 is formed by the thickness of 25-80 [nm] (preferably 30-60 [nm]). Although there is no limitation in the material of a crystalline-substance semiconductor film, it is good to form with silicon or a silicon germanium (SiGe) alloy preferably.

[0100] In order to produce a crystalline-substance semiconductor film by the laser crystallizing method, a pulse oscillation type or a continuation luminescence type excimer laser, and an YAG laser and YVO4 laser are used. When using such laser, it is good to use the method of condensing to a line the laser beam emitted from the laser oscillation machine with optical system, and irradiating a semiconductor film. Although an operation person does **** selection, the conditions of crystallization are made into the pulse oscillation frequency 30 [Hz] when using an excimer laser, and set a laser energy density to 100-400 [mJ/cm2] (typically 200-300 [mJ/cm2]). Moreover, it is good to consider as the pulse oscillation frequency 1-10 [kHz] using the 2nd higher harmonic, in using an YAG laser, and to set a laser energy density to 300-600 [mJ/cm2] (typically 350-500 [mJ/cm2]). and width of face 100-1000 [mum], for example, the laser beam which condensed to the line by 400 [mum], -- the whole substrate surface -- crossing -- irradiating -- the line at this time -- the rate of superposition of a laser beam (rate of overlap) is performed as 80-98 [%]

[0101] Subsequently, the wrap gate insulator layer 5007 is formed for the island-like semiconductor layers 5003-5006. The gate insulator layer 5007 is formed using a plasma CVD method or a spatter by the insulator layer which sets thickness to 40-150 [nm], and contains silicon. At this example, it forms by the oxidization silicon nitride film by the thickness of 120 [nm]. Of course, a gate insulator layer is not limited to such an oxidization silicon nitride film, and may use the insulator layer containing other silicon as a monolayer or a laminated structure. For example, when using a silicon-oxide film, TEOS (Tetraethyl Orthosilicate) and O2 can be mixed by the plasma CVD method, and it can consider as reaction pressure 40 [Pa] and the substrate temperature 300-400 [**], it can be made to be able to discharge by the RF (13.56 [MHz]) and power flux density 0.5-0.8 [W/cm2], and can form. Thus, the silicon-oxide film produced can acquire a property good as a gate insulator layer by heat annealing of

400-500 [**] after that.
[0102] And the 1st electric conduction film 5008 for forming a gate electrode on the gate insulator layer 5007 and the 2nd electric conduction film 5009 are formed. In this example, the 1st electric conduction film 5008 is formed in the thickness of 50-100 [nm] by Ta, and the 2nd electric conduction film 5009 is formed in the thickness of 100-300 [nm] by W.
[0103] By the spatter, Ta film is formed by carrying out the spatter of the target of Ta by Ar. In this case, if Xe and Kr of optimum dose are added to Ar, the internal stress of Ta film can be eased and ablation of a film can be prevented. Moreover, although the resistivity of Ta film of alpha phase is 20 [muomegacm] grades and it can be used for a gate electrode, the resistivity of Ta film of beta phase is unsuitable for being 180 [muomegacm] grades and considering as a gate electrode. If the tantalum nitride with the crystal structure near alpha phase of Ta is formed in the ground of Ta by the thickness about 10-50 [nm] in order to form Ta film of alpha phase, Ta film of alpha phase can be obtained easily.
[0104] In forming W film, it forms W by the spatter used as the target. In addition, it can also form by the heat CVD using 6 tungsten fluoride (WF6). Anyway, in order to use it as a gate electrode, it is necessary to attain low resistance-ization, and as for the resistivity of W film, carrying out to below 20 [muomegacm] is desirable. In W, although W film can attain low resistivity-ization by enlarging crystal grain, when there are many impurity elements, such as oxygen, crystallization is checked and forms it into high resistance. From this, when based on a spatter, resistivity 9-20 [muomegacm] can be realized using W target of purity 99.9999 [%] by considering enough and forming W film so that there may be no mixing of the impurity out of a gaseous phase further at the time of membrane formation.
[0105] In addition, at this example, although Ta and the 2nd electric conduction film 5009 were set to W for the 1st electric conduction film 5008, it is not limited especially but the element chosen from any Ta, W, Ti, Mo, aluminum, and Cu etc. or the aforementioned element may be formed with the charge of an alloy or compound material made into a principal component. Moreover, you may use the semiconductor film represented by the polycrystal silicon film which doped impurity elements, such as Lynn. As a desirable thing, with an example of other combination other than this example Form the 1st electric conduction film 5008 by the tantalum nitride (TaN), and set the 2nd electric conduction film 5009 to W, and it is combined. The 1st electric conduction film 5008 is formed by the tantalum nitride (TaN), it combines, the 1st electric conduction film 5008 is formed by the tantalum nitride (TaN), and the combination for which the 2nd electric conduction film 5009 is set to aluminum and which sets the 2nd electric conduction film 5009 to Cu is mentioned.
[0106] Next, 1st etching processing for forming the mask 5010 by the resist and forming an electrode and wiring is performed. In this example, it carries out by mixing CF4 and Cl2 in the gas for etching, supplying RF (13.56 [MHz]) power of 500 [W] to a coil type electrode by the pressure of 1 [Pa] using the ICP (Inductively Coupled Plasma:inductive-coupling type plasma) etching method, and generating plasma. RF (13.56 [MHz]) power of 100 [W] is supplied also to a substrate side (sample stage), and negative auto-bias voltage is impressed substantially. When CF4 and Cl2 are mixed, it **********s to the same extent in W film and Ta film.
[0107] On the above-mentioned etching conditions, the edge of the 1st conductive layer and the 2nd conductive layer serves as a taper configuration according to the effect of the bias voltage impressed to a substrate side by having been suitable in the configuration of the mask by the resist. The angle of the taper section becomes 15-45 degrees. In order to ********** without leaving a residue on a gate insulator layer, it is good to make etching time increase at a rate about 10-20 [%]. Since the selection ratios of the oxidization silicon nitride film to W film are 2-4 (typically 3), as for the field which the oxidization silicon nitride film exposed, over etching processing will ********** 20-50 [nm] grade. In this way, the conductive layers 5011-5016 (the 1st conductive layers 5011a-5016a and 2nd conductive layer 5011b-5016b) of the 1st configuration which consists of the 1st conductive layer and 2nd conductive layer by 1st etching processing are formed. At this time, the field where it **********ed 20-50 [nm] grade, and the field which is not covered by the conductive layers 5011-5016 of the 1st configuration became thin is formed in the gate insulator layer 5007. (Drawing 8 (B))

[0108] And the impurity element which performs 1st doping processing and gives n type is added. What is necessary is just to perform the method of doping with the ion doping method or ion-implantation. The conditions of the ion doping method set a dose to 1x1013 to 5x1014 [atoms/cm2], and perform acceleration voltage as 60-100 [keV]. the element which belongs to 15 groups as an impurity element which gives n type -- typical -- Lynn -- although (P) or arsenic (As) is used -- here -- Lynn -- (P) is used In this case, it becomes a mask to the impurity element with which conductive layers 5011-5015 give n type, and the 1st impurity range 5017-5025 is formed in a self-adjustment target. To the 1st impurity range 5017-5025, the impurity element which gives n type by the density range of 1x1020 to 1x1021 [atoms/cm3] is added. (Drawing 8 (B))

[0109] Next, as shown in drawing 8 (C), a resist mask performs 2nd etching processing, not removed. CF4, and Cl2 and O2 are used for etching gas, and W film is **********ed alternatively. At this time, the conductive layers 5026-5031 (the 1st conductive layers 5026a-5031a and 2nd conductive layer 5026b-5031b) of the 2nd configuration are formed by 2nd etching processing. At this time, the field where it **********ed to the pan 20-50 [nm] grade, and the field which is not covered by the conductive layers 5026-5031 of the 2nd configuration became thin is formed in the gate insulator layer 5007.

[0110] The etching reaction by the mixed gas of CF4 and Cl2 of W film or Ta film can be guessed from the vapor pressure of the radical or ion kind generated, and a resultant. If the vapor pressure of the fluoride and chloride of W and Ta is compared, WF6 which is the fluoride of W is extremely high, and WCl5, TaF5, and TaCl5 of others have it. [of the same grade] Therefore, in the mixed gas of CF4 and Cl2, it **********s in W film and Ta film. However, if O2 of optimum dose is added to this mixed gas, CF4 and O2 will react, it will be set to CO and F, and F radical or F ion will occur so much. Consequently, the etch rate of W film with the high vapor pressure of a fluoride increases. On the other hand, even if, as for Ta, F increases, there are few increases in an etch rate relatively. Moreover, since Ta tends to oxidize as compared with W, the front face of Ta oxidizes by adding O2. In order that the oxide of Ta may react neither with a fluorine nor chlorine, the etch rate of Ta film falls further. Therefore, it becomes possible to become possible to make a difference to the etch rate of W film and Ta film, and to make the etch rate of W film larger than Ta film.

[0111] And as shown in drawing 9 (A), 2nd doping processing is performed. In this case, the impurity element which lowers a dose and gives n type as conditions for high acceleration voltage rather than the 1st doping processing is doped. For example, a new impurity range is formed inside the 1st impurity range which set acceleration voltage to 70-120 [keV], carried out by the dose of 1x1013 [atoms/cm2], and was formed in the island-like semiconductor layer by drawing 8 (B). Doping uses the conductive layers 5026-5030 of the 2nd configuration as a mask to an impurity element, and it dopes them so that an impurity element may be added by the field of the 1st conductive-layera [5026]-5030a bottom. In this way, the 3rd impurity range 5032-5036 is formed. The concentration of Lynn (P) added by this 3rd impurity range 5032-5036 has the loose concentration gradient according to the thickness of the taper section of the 1st conductive layer 5026a-5030a. In addition, in the semiconductor layer which laps with the taper section of the 1st conductive layer 5026a-5030a, although high impurity concentration is low a little toward the edge of the taper section of the 1st conductive layer 5026a-5030a to the inside, it is concentration almost of the same grade.

[0112] As shown in drawing 9 (B), 3rd etching processing is performed. CHF6 is used for etching gas and it carries out using a reactive-ion-etching method (the RIE method). The field where the taper section of the 1st conductive layer 5026a-5031a is **********ed partially, and the 1st conductive layer laps with a semiconductor layer by 3rd etching processing is reduced. By 3rd etching processing, the conductive layers 5037-5042 (the 1st conductive layers 5037a-5042a and 2nd conductive layer 5037b-5042b) of the 3rd configuration are formed. At this time, the field where it **********ed to the pan 20-50 [nm] grade, and the field which is not covered by the conductive layers 5037-5042 of the 3rd configuration became thin is formed in the gate insulator layer 5007.

[0113] The 2nd impurity range 5032b-5036b between the 3rd impurity range 5032a-5036a

which laps with the 1st conductive layer 5037a–5041a in the 3rd impurity range 5032–5036 by 3rd etching processing, and the 1st impurity range and the 3rd impurity range is formed.
[0114] And as shown in drawing 9 (C), the 4th impurity range 5043–5054 of a conductivity type contrary to the 1st conductivity type is formed in the island–like semiconductor layers 5004 and 5006 which form p–channel type TFT. The conductive layers 5038b and 5041b of the 3rd configuration are used as a mask to an impurity element, and an impurity range is formed in a self–adjustment target. At this time, the island–like semiconductor layers 5003 and 5005 and the wiring section 5042 which form n channel type TFT cover the whole surface with the resist mask 5200. Although Lynn is added by impurity ranges 5043–5054 by concentration different, respectively, it forms by the ion doping method using the diboron hexahydride (B–2 H6), and is made for high impurity concentration to be set to 2x1020 to 2x1021 [atoms/cm3] also in which the field.
[0115] An impurity range is formed in each island–like semiconductor layer at the process to the above. The conductive layers 5037–5041 of the 3rd configuration which lap with an island–like semiconductor layer function as a gate electrode. Moreover, 5042 functions as an island–like source signal line.
[0116] After removing the resist mask 5200, the process which activates the impurity element added by each island–like semiconductor layer for the purpose of control of a conductivity type is performed. This process is performed by the heat annealing method for using a furnace annealing furnace. In addition, the laser annealing method or the rapid thermal annealing method (the RTA method) is applicable. By the heat annealing method, preferably, in the nitrogen–gas–atmosphere mind below 0.1 [ppm], it carries out by 500–600 [**] typically, and an oxygen density performs [400–700 [**] and] heat treatment of 4 hours this example below 1 [ppm] 500 [**]. However, it is desirable to be activated after forming a layer insulation film (let silicon be a principal component) in order to protect wiring etc., when the wiring material used for the conductive layers 5037–5042 of the 3rd configuration is weak with heat.
[0117] Furthermore, in the atmosphere containing the hydrogen of 3–100 [%], heat treatment of 1 – 12 hours is performed by 300–450 [**], and the process which hydrogenates an island–like semiconductor layer is performed. This process is a process which carries out termination of the dangling bond of a semiconductor layer by the hydrogen excited thermally. As other meanses of hydrogenation, you may perform plasma hydrogenation (the hydrogen excited by plasma is used).
[0118] Subsequently, as shown in drawing 10 (A), the 1st layer insulation film 5055 is formed by the thickness of 100–200 [nm] from an oxidization silicon nitride film. the 1st [after forming the 2nd layer insulation film 5056 which consists of an organic insulator material on it] layer insulation film 5055, the 2nd layer insulation film 5056, and the gate insulator layer 5007 — receiving — a contact hole — forming — each wiring (connection wiring and signal line are included) 5057– after carrying out patterning formation of 5062 and 5064, patterning formation of the pixel electrode 5063 which meets with the connection wiring 5062 is carried out
[0119] As 2nd layer insulation film 5056, a polyimide, a polyamide, an acrylic, BCB (benz–cyclo–butene), etc. can be used as the organic resin using a film made from an organic resin. Since especially the 2nd layer insulation film 5056 has the strong implications of flattening, its acrylic excellent in flat nature is desirable. At this example, an acrylic film is formed by the thickness which can fully carry out flattening of the level difference formed of TFT. desirable — 1–5 [mum] (still more preferably 2–4 [mum]) — then, it is good
[0120] Formation of a contact hole forms the contact hole which reaches the n type impurity ranges 5017, 5018, 5021, and 5023 and the p type impurity ranges 5043–5054, the contact hole which reaches wiring 5042, the contact hole (not shown) which reaches a current supply line, and the contact hole (not shown) which reaches a gate electrode using dry etching or wet etching, respectively.
[0121] moreover, wiring (connection wiring and signal line are included) 5057– what carried out patterning of the cascade screen of the three–tiered structure which carried out the

aluminum film which contains 100 [nm] and Ti for Ti film by 300 [nm] as 5062 and 5064, and carried out continuation formation of the Ti film 150 [nm] by the spatter to the desired configuration is used Of course, you may use other electric conduction films.
[0122] Moreover, in this example, the ITO film was formed in the thickness of 110 [nm] as a pixel electrode 5063, and patterning was performed. Contact is taken by arranging the pixel electrode 5063 so that it may lap in contact with the connection wiring 5062. Moreover, you may use for indium oxide the transparent electric conduction film which mixed the zinc oxide (ZnO) of 2-20 [%]. This pixel electrode 5063 turns into an anode plate of an EL element. (Drawing 10 (A))
[0123] Next, as shown in drawing 10 (B), the insulator layer (this example oxidization silicon film) containing silicon is formed in the thickness of 500 [nm], opening is formed in the position corresponding to the pixel electrode 5063, and the 3rd layer insulation film 5065 which functions as a bank is formed. In case opening is formed, it can consider as the side attachment wall of a taper configuration easily by using the wet etching method. Since degradation of EL layer resulting from a level difference will pose a remarkable problem if the side attachment wall of opening is not fully gently-sloping, cautions are required.
[0124] Next, continuation formation of the EL layer 5066 and the cathode (MgAg electrode) 5067 is carried out without carrying out air release using a vacuum deposition method. In addition, the thickness of the EL layer 5066 should just set thickness of 80-200 [nm] (typically 100-120 [nm]), and cathode 5067 to 180-300 [nm] (typically 200-250 [nm]).
[0125] At this process, EL layer and cathode are formed one by one to the pixel corresponding to red, the pixel which corresponds green, and the pixel which corresponds blue. however, the ** which does not use photolithography technology since EL layer is lacking in the resistance over a solution -- each color -- you have to form individually Then, it is desirable that hide except a desired pixel using a metal mask, and only a required part forms EL layer and cathode alternatively.
[0126] That is, the mask which hides except [all] the pixel corresponding to red first is set, and EL layer of red luminescence is alternatively formed using the mask. Subsequently, the mask which hides except [all] the pixel which corresponds green is set, and EL layer of green luminescence is alternatively formed using the mask. Subsequently, the mask which hides except [all] the pixel which corresponds blue similarly is set, and EL layer of blue luminescence is alternatively formed using the mask. In addition, although it has indicated that a mask which is altogether different here is used, you may use the same mask about.
[0127] Although the method which forms three kinds of EL elements corresponding to RGB was used here, you may use the method which combined the method which combined the EL element and light filter of white luminescence, blue, or the EL element and fluorescent substance (color conversion layer of fluorescence nature : CCM) of bluish green luminescence, the method which puts the EL element corresponding to RGB on cathode (counterelectrode) using a transparent electrode.
[0128] In addition, a material well-known as an EL layer 5066 can be used. As a well-known material, when driver voltage is taken into consideration, it is desirable to use an organic material. For example, what is necessary is just to let four layer structures which become in a hole-injection layer, an electron hole transporting bed, a luminous layer, and an electron-injection layer be EL layers.
[0129] Next, on the pixel (pixel of the same line) which has TFT for switching by which the gate electrode was connected to the same gate signal line, a metal mask is used and cathode 5067 is formed. In addition, although MgAg was used as cathode 5067 in this example, this invention is not limited to this. You may use other well-known material as cathode 5067.
[0130] The passivation film 5068 which becomes the last by the silicon nitride film is formed in the thickness of 300 [nm]. By forming the passivation film 5068, the EL layer 5066 can be protected from moisture etc. and the reliability of an EL element can be raised further.
[0131] In this way, EL display of structure as shown in drawing 10 (B) is completed. In addition, in the production process of EL display in this example, on the composition of a circuit, and the relation of a process, although the gate signal line is formed by aluminum

which is the wiring material which forms a source signal line and forms the drain source electrode by Ta and W which are the material which forms the gate electrode, you may use a different material.

[0132] By the way, by arranging TFT of the optimal structure not only for the pixel section but the drive circuit section, EL display of this example shows very high reliability, and its operating characteristic may also improve. Moreover, it is also possible to add metal catalysts, such as nickel, in a crystallization process, and to raise crystallinity. It is possible to carry out drive frequency of a source signal-line drive circuit by it more than 10 [MHz].

[0133] First, TFT which has the structure of reducing hot carrier pouring so that a working speed may not be reduced as much as possible is used as n channel type TFT of the CMOS circuit which forms the drive circuit section. In addition, as a drive circuit here, the transmission gate in a shift register, a buffer, a level shifter, the latch in a line sequential drive, and a point sequential drive etc. is contained.

[0134] In the case of this example, the barrier layer of n channel type TFT includes a source field, a drain field, the overlap LDD field (LOV field) that laps with a gate electrode on both sides of a gate insulator layer in between, the offset LDD field (LOFF field) which does not lap with a gate electrode on both sides of a gate insulator layer in between, and a channel formation field.

[0135] Moreover, since degradation by hot carrier pouring hardly worries p-channel type TFT of a CMOS circuit, it does not need to prepare especially a LDD field. Of course, it is also possible to prepare a LDD field like n channel type TFT, and to take the cure against a hot carrier.

[0136] In addition, in a drive circuit, when a CMOS circuit to which current flows a channel formation field bidirectionally, i.e., a CMOS circuit which the role of a source field and a drain field replaces, is used, as for n channel type TFT which forms a CMOS circuit, it is desirable to form a LDD field in the form which inserts a channel formation field into both the sides of a channel formation field. As such an example, the transmission gate used for a point sequential drive is mentioned. Moreover, in a drive circuit, when a CMOS circuit with the need of stopping the OFF state current low as much as possible is used, as for n channel type TFT which forms a CMOS circuit, it is desirable to have the LOV field. As such an example, the transmission gate used for a point sequential drive is mentioned too.

[0137] In addition, when completing to the state of drawing 10 (B) in fact, airtightness is high and it is desirable to carry out packaging (enclosure) by the sealing material of the few protection films (a laminate film, ultraviolet-rays hardening resin film, etc.) of degasifying or a translucency so that the open air may not ** further. In that case, if the interior of a sealing material is made into an inert atmosphere or a hygroscopic material (for example, barium oxide) is arranged inside, the reliability of an EL element will improve.

[0138] Moreover, if processing of packaging etc. raises airtightness, the connector (flexible print circuit : FPC) for connecting the terminal and external signal terminal which were taken about from the element formed on the substrate or the circuit will be attached, and it will complete as a product. The state where it changed into such a state where it can ship is called display in this specification.

[0139] Moreover, if the process shown by this example is followed, the number of photo masks required for production of display can be stopped. Consequently, a process can be shortened and it can contribute to reduction of a manufacturing cost, and improvement in the yield.

[0140] (Example 4) Drawing 11 (A) is a plan of EL display which uses the drive method of this invention. In drawing 11 (A), for 4010, as for the pixel section and 4012, a substrate and 4011 are [a source signal-line drive circuit and 4013] gate signal side drive circuits, and each drive circuit results in FPC4017 through wiring 4014 and 4016, and is connected to an external instrument.

[0141] this time -- at least -- the pixel section -- as a drive circuit and the pixel section are surrounded preferably, the covering material 6000, the sealing material (it is also called housing material) 7000, and the sealant (the 2nd sealing material) 7001 are formed

[0142] Moreover, drawing 11 (B) is the cross-section structure of EL display of this example,

and TFT4022 for drive circuits (however, the CMOS circuit which combined n channel type TFT and p-channel type TFT here is illustrated.), and TFT4023 (however, only the TFT for EL drive is illustrated here.) for the pixel sections are formed on the substrate 4010 and the ground film 4021. Such TFT should just use well-known structures (top gate structure or bottom gate structure).

[0143] If TFT4022 for drive circuits and TFT4023 for the pixel sections are completed, the pixel electrode 4027 which becomes by the transparent electric conduction film electrically connected with the drain of TFT4023 for the pixel sections will be formed on the layer insulation film (flattening film) 4026 which becomes with resin material. As a transparent electric conduction film, the compound (referred to as ITO) of indium oxide and the tin oxide or the compound of indium oxide and a zinc oxide can be used. And if the pixel electrode 4027 is formed, an insulator layer 4028 will be formed and opening will be formed on the pixel electrode 4027.

[0144] Next, the EL layer 4029 is formed. What is necessary is just to make the EL layer 4029 into a laminated structure or monolayer structure, combining freely well-known EL material (a hole-injection layer, an electron hole transporting bed, a luminous layer, an electronic transporting bed, and electron-injection layer). As what structure it considers should just use well-known technology. Moreover, there are low-molecular system material and macromolecule system (polymer system) material as EL material. Although a vacuum deposition is used when using low-molecular system material, when using macromolecule system material, it is possible to use simple methods, such as the spin coat method, print processes, or the ink-jet method.

[0145] In this example, EL layer is formed by the vacuum deposition using a shadow mask. By forming the luminous layer (a red luminous layer, a green luminous layer, and blue luminous layer) in which luminescence from which wavelength differs for every pixel using a shadow mask is possible, color display becomes possible. In addition, although there are a method which combined the color conversion layer (CCM) and the light filter, and a method which combined the white luminous layer and the light filter, you may use which method. Of course, it can also consider as EL display of monochrome luminescence.

[0146] If the EL layer 4029 is formed, cathode 4030 will be formed on it. As for the moisture which exists in the interface of cathode 4030 and the EL layer 4029, or oxygen, eliminating as much as possible is desirable. Therefore, the device of forming cathode 4030 without carrying out continuation membrane formation of the EL layer 4029 and the cathode 4030 in a vacuum, or forming the EL layer 4029 by the inert atmosphere and carrying out air release is required. At this example, the above membrane formation is enabled by using the membrane formation equipment of a multi chamber method (cluster tool method).

[0147] In addition, in this example, the laminated structure of a LiF (lithium fluoride) film and aluminum (aluminum) film is used as cathode 4030. The LiF (lithium fluoride) film of 1nm ** is specifically formed by the vacuum deposition on the EL layer 4029, and the aluminum film of 300nm ** is formed on it. Of course, you may use the MgAg electrode which is a well-known cathode material. And cathode 4030 is connected to wiring 4016 in the field shown by 4031. Wiring 4016 is a current supply line for giving predetermined voltage to cathode 4030, and is connected to FPC4017 through the conductive paste material 4032.

[0148] In order to connect cathode 4030 and wiring 4016 electrically in the field shown in 4031, it is necessary to form a contact hole in the layer insulation film 4026 and an insulator layer 4028. What is necessary is just to form these at the time of etching of the layer insulation film 4026, and etching of an insulator layer 4028 (at the time of formation of the contact hole for pixel electrodes) (at the time of formation of opening in front of EL stratification). Moreover, in case an insulator layer 4028 is **********ed, even the layer insulation film 4026 may ********** by package. In this case, if the layer insulation film 4026 and an insulator layer 4028 are the same resin material, let the configuration of a contact hole be a good thing.

[0149] Thus, the front face of the formed EL element is worn and the passivation film 6003, a filler 6004, and the covering material 6000 are formed.

[0150] Furthermore, as the EL-element section is surrounded, a sealing material 7000 is formed between the covering material 6000 and a substrate 4010, and a sealant (the 2nd sealing material) 7001 is further formed in the outside of a sealing material 7000.
[0151] At this time, this filler 6004 functions also as adhesives for pasting up the covering material 6000. As a filler 6004, PVC (polyvinyl chloride), an epoxy resin, silicone resin, and PVB (polyvinyl butyral) or EVA (ethylene vinyl acetate) can be used. If the drying agent is prepared in the interior of this filler 6004, since the moisture absorption effect can be held, it is desirable.
[0152] Moreover, you may make a spacer contain in a filler 6004. At this time, a spacer may be made into the particulate matter which consists of BaO etc., and hygroscopicity may be given to the spacer itself.
[0153] When a spacer is formed, the passivation film 6003 can ease spacer **. Moreover, you may prepare the resin film which eases spacer ** independently [the passivation film 6003].
[0154] Moreover, as covering material 6000, a glass plate, an aluminum plate, a stainless steel board, an FRP (Fiberglass-Reinforced Plastics) board, a PVF (polyvinyl fluoride) film, a Mylar film, polyester film, or an acrylic film can be used. In addition, when using PVB and EVA as a filler 6004, it is desirable to use the sheet of the structure which sandwiched the dozens of micrometers aluminium wheel with the PVF film or the Mylar film.
[0155] However, depending on the luminescence direction (the direction of a light emission) from an EL element, the covering material 6000 needs to have a translucency.
[0156] Moreover, wiring 4016 is electrically connected to FPC4017 through the crevice between a sealing material 7000 and a sealant 7001, and a substrate 4010. In addition, although wiring 4016 was explained here, other wiring 4014 is similarly connected to FPC4017 electrically through the bottom of a sealing material 7000 and a sealant 7001.
[0157] In addition, although the sealing material 7000 is attached in drawing 11 so that the covering material 6000 may be pasted up and the side (disclosure side) of a filler 6004 may be worn after forming a filler 6004, after attaching the covering material 6000 and a sealing material 7000, you may form a filler 6004. In this case, the inlet of the filler which leads to the opening currently formed by the substrate 4010, the covering material 6000, and the sealing material 7000 is prepared. And the aforementioned opening is made into a vacua (10 to 2 or less Torrs), and after dipping an inlet in the tank containing the filler, atmospheric pressure besides an opening is made higher than the atmospheric pressure in an opening, and it is filled up with a filler into an opening.
[0158] (Example 5) Next, the example which produced EL display of a different gestalt from drawing 11 (A) and (B) is explained using drawing 12 (A) and (B). Since the thing of the same number as drawing 11 (A) and (B) has pointed out the same portion, explanation is omitted.
[0159] Drawing 12 (A) is the plan of EL display of this example, and shows the cross section which cut drawing 12 (A) by A-A' to drawing 12 (B).
[0160] According to drawing 11 , the front face of an EL element is worn and even the passivation film 6003 is formed.
[0161] Furthermore, a filler 6004 is formed as an EL element is covered. This filler 6004 functions also as adhesives for pasting up the covering material 6000. As a filler 6004, PVC (polyvinyl chloride), an epoxy resin, silicone resin, and PVB (polyvinyl butyral) or EVA (ethylene vinyl acetate) can be used. If the drying agent is prepared in the interior of this filler 6004, since the moisture absorption effect can be held, it is desirable.
[0162] Moreover, you may make a spacer contain in a filler 6004. At this time, a spacer may be made into the particulate matter which consists of BaO etc., and hygroscopicity may be given to the spacer itself.
[0163] When a spacer is formed, the passivation film 6003 can ease spacer **. Moreover, apart from a passivation film, you may prepare the resin film which eases spacer **.
[0164] Moreover, as covering material 6000, a glass plate, an aluminum plate, a stainless steel board, an FRP (Fiberglass-Reinforced Plastics) board, a PVF (polyvinyl fluoride) film, a Mylar film, polyester film, or an acrylic film can be used. In addition, when using PVB and EVA as a filler 6004, it is desirable to use the sheet of the structure which sandwiched the dozens of

micrometers aluminium wheel with the PVF film or the Mylar film.
[0165] However, depending on the luminescence direction (the direction of a light emission) from an EL element, the covering material 6000 needs to have a translucency.
[0166] Next, after pasting up the covering material 6000 using a filler 6004, a frame material 6001 is attached so that the side (disclosure side) of a filler 6004 may be worn. A frame material 6001 is pasted up by the sealing material (it functions as adhesives) 6002. Although it is desirable at this time to use a photoresist as a sealing material 6002, you may use thermosetting resin, as long as the thermal resistance of EL layer allows. In addition, as for a sealing material 6002, it is desirable that it is the material which penetrates neither moisture nor oxygen as much as possible. Moreover, the drying agent may be added inside the sealing material 6002.
[0167] Moreover, wiring 4016 is electrically connected to FPC4017 through the crevice between a sealing material 6002 and a substrate 4010. In addition, although wiring 4016 was explained here, other wiring 4014 is similarly connected to FPC4017 electrically through the bottom of a sealing material 6002.
[0168] In addition, although the frame material 6001 is attached in drawing 12 so that the covering material 6000 may be pasted up and the side (disclosure side) of a filler 6004 may be worn after forming a filler 6004, after attaching the covering material 6000 and a frame material 6001, you may form a filler 6004. In this case, the inlet of the filler which leads to the opening currently formed by the substrate 4010, the covering material 6000, and the frame material 6001 is prepared. And the aforementioned opening is made into a vacua (10 to 2 or less Torrs), and after dipping an inlet in the tank containing the filler, atmospheric pressure besides an opening is made higher than the atmospheric pressure in an opening, and it is filled up with a filler into an opening.
[0169] (Example 6) The still more detailed cross-section structure of the pixel section in EL display is shown in drawing 13 . In drawing 13 , TFT4502 for switching prepared on the substrate 4501 uses n channel type TFT formed using the well-known method. In this example, it is considering as the double-gate structure of having two gate electrodes 39a and 39b. It becomes the structure where the serial of the two TFT was substantially carried out by considering as double-gate structure, and there is an advantage that an OFF state current value can be reduced. In addition, although considered as double-gate structure in this example, single-gate structure is sufficient and multi-gate structure with triple gate structure or the gate number beyond it is sufficient. Moreover, you may use p-channel type TFT formed using the well-known method.
[0170] Moreover, TFT4503 for EL drive uses n channel type TFT formed using the well-known method. By wiring 36, the gate electrode 37 of TFT for EL drive is electrically connected to the drain wiring 35 of TFT4502 for switching.
[0171] Since TFT for EL drive is an element for controlling the amount of current which flows an EL element, much current flows and the danger of degradation by heat or degradation by the hot carrier is also a high element. Therefore, the structure of this invention of preparing a LDD field so that it may lap with the drain side of TFT4503 for EL drive through a gate insulator layer at a gate electrode is very effective.
[0172] Moreover, although the single-gate structure of having one gate electrode 37 is illustrating TFT4503 for EL drive in this example, it is good also as multi-gate structure where two or more TFT was connected in series. Furthermore, it is good also as structure which connects two or more TFT in parallel, divides a channel formation field into plurality substantially, and enabled it to emit heat at high efficiency. Such structure is effective as a cure against degradation by heat.
[0173] Moreover, in this example, although top gate type TFT is used, you may use bottom gate type TFT.
[0174] Moreover, the source wiring 40 is connected to a current supply line (not shown), and fixed voltage is always applied.
[0175] The 1st passivation film 41 is formed on TFT4502 for switching, and TFT4503 for EL drive, and the flattening film 42 which becomes by the resin insulator layer is formed on it. It

is very important to carry out flattening of the level difference by TFT using the flattening film 42. Since EL layer formed behind is very thin, poor luminescence may be caused when a level difference exists. Therefore, before forming a pixel electrode so that EL layer can be formed as much as possible in a flat side, it is desirable to carry out flattening.

[0176] Moreover, 43 is a pixel electrode (cathode of an EL element in this case) which becomes by the high electric conduction film of reflection nature, and is electrically connected to the drain wiring 33 of TFT4503 for EL drive. as the pixel electrode 43 — an aluminium alloy film, a copper alloy film, or a silver-alloy film — low — it is desirable to use electric conduction [****] films or those cascade screens Of course, it is good also as a laminated structure with other electric conduction films.

[0177] Moreover, a luminous layer 45 is formed into the slot (it is equivalent to a pixel) formed of the banks 44a and 44b formed by the insulator layer (preferably resin). In addition, although only 1 pixel is illustrated here, you may make and divide the luminous layer corresponding to each color of R (red), G (green), and B (blue). pi conjugate polymer system material is used as an organic EL material made into a luminous layer. As a typical polymer system material, a poly para-phenylene vinylene (PPV) system, a polyvinyl-carbazole (PVK) system, the poly fluorene system, etc. are mentioned.

[0178] In addition, what is necessary is just to use material which was indicated by "H.Shenk, H.Becker, O.Gelsen, E.Kluge, W.Kreuder, and H.Spreitzer, "Polymers forLight Emitting Diodes", Euro Display, Proceedings, 1999, p.33-37", and JP,10-92576,A, for example, although there is a thing of various molds as a PPV system organic EL material.

[0179] What is necessary is to use a polyphenylene vinylene for a cyano polyphenylene vinylene and the luminous layer which emits light green, and just to use a polyphenylene vinylene or the poly alkyl phenylene for the luminous layer which emits light blue at the luminous layer which emits light in red as a concrete luminous layer. thickness — 30-150nm (preferably 40-100nm) — then, it is good

[0180] However, the above example is an example of organic EL material which can be used as a luminous layer, and there is no need of limiting to this. What is necessary is just to form EL layer (layer for moving luminescence and the carrier for it), combining freely a luminous layer, a charge transporting bed, or a charge pouring layer.

[0181] For example, although this example showed the example which uses polymer system material as a luminous layer, you may use low-molecular system organic EL material. Moreover, it is also possible to use inorganic material, such as a silicon carbide, as a charge transporting bed or a charge pouring layer. Such organic EL material and inorganic material can use a well-known material.

[0182] In this example, it is considering as EL layer of the laminated structure which formed the hole-injection layer 46 which becomes by PEDOT (poly thiophene) or PAni (poly aniline) on the luminous layer 45. And on the hole-injection layer 46, the anode plate 47 which becomes by the transparent electric conduction film is formed. Since light generated by the luminous layer 45 is emitted toward an upper surface side in the case of this example (going in the direction where the substrate 4501 in which TFT was formed is opposite), an anode plate must be a translucency. Although the compound of indium oxide and the tin oxide and the compound of indium oxide and a zinc oxide can be used as a transparent electric conduction film, after forming a heat-resistant low luminous layer and a heat-resistant hole-injection layer, in order to form, what can form membranes at low temperature as much as possible is desirable.

[0183] When formed to an anode plate 47, EL element 4505 is completed. In addition, EL element 4505 here is formed by the pixel electrode (cathode) 43, the luminous layer 45, the hole-injection layer 46, and the anode plate 47. Since the area of a pixel is made to carry out simultaneously coincidence of the pixel electrode 43, the whole pixel functions as an EL element. Therefore, the use efficiency of luminescence is very high and the bright image display of it becomes possible.

[0184] Moreover, in this example, the 2nd passivation film 48 is further formed on the anode plate 47. As the 2nd passivation film 48, a silicon nitride film or a nitriding oxidization silicon

film is desirable. This purpose is intercepting the exterior and an EL element, and has both the meaning which prevents degradation by oxidization of organic EL material, and the meaning which suppresses degasifying from organic EL material. Thereby, the reliability of EL display is raised.

[0185] As mentioned above, EL display using the drive method of this invention has the pixel section which consists of a pixel of structure like drawing 13 , and fully has TFT for low switching and TFT for EL drive strong against hot carrier pouring of an OFF state current value. Therefore, it has high reliability and EL display in which good image display is possible is obtained.

[0186] (Example 7) this example explains the structure where the structure of EL element 4505 was reversed, in the pixel section shown in the example 6. Drawing 14 is used for explanation. In addition, since different points from the structure of drawing 13 are only the portion of an EL element, and TFT for EL drive, other explanation is given to omit.

[0187] In drawing 14 , TFT4503 for EL drive uses p-channel type TFT formed using the well-known method.

[0188] In this example, a transparent electric conduction film is used as a pixel electrode (anode plate) 50. The electric conduction film which specifically becomes with the compound of indium oxide and a zinc oxide is used. Of course, you may use the electric conduction film which becomes with the compound of indium oxide and the tin oxide.

[0189] And after the banks 51a and 51b which become by the insulator layer are formed, the luminous layer 52 which becomes by the polyvinyl carbazole by solution application is formed. The electron-injection layer 53 which becomes by potassium acetylacetonate (written as acacK) on it, and the cathode 54 which becomes by the aluminium alloy are formed. In this case, cathode 54 functions also as a passivation film. In this way, EL element 4701 is formed.

[0190] In the case of this example, the light generated in the luminous layer 52 is emitted toward the direction of the substrate 4501 in which TFT was formed as shown by the arrow.

[0191] (Example 8) this example explains the composition of a source signal-line drive circuit.

[0192] The circuit diagram of a source signal-line drive circuit is shown in drawing 6 . It is arranged as shift register 8801, latch (A), (8802), and latch (B) and (8803) ** shows in drawing. In this example, 1 set of latches (A), (8802), 1 set of latches (B), and (8803) correspond to four source signal-line S_a-S_d. Moreover, although the level shifter which changes the width of face of the amplitude of the voltage which a signal has was not prepared in this example, you may make a designer prepare suitably.

[0193] Clock signal CLKB, the start pulse signal SP, and driving-direction change signal SL/R which the polarity of clock signals CLK and CLK reversed are inputted into a shift register 8801 from the wiring shown in drawing, respectively. Moreover, the digital signal VD inputted from the outside is quadrisected, and is inputted into a latch (A) and (8802) from the wiring shown in drawing. Signal S_LATb which the polarity of latch signal S_Local Area Transport and S_Local Area Transport reversed is inputted into a latch (B) and (8803) from the wiring shown in drawing, respectively.

[0194] If the signal from a shift register 8801 is inputted, a latch (A) and (8802) will acquire four signals simultaneously from the quadrisected digital signal VD. By latch signal S_Local Area Transport and S_LATb, a latch (B) and (8803) hold a digital signal VD, and it outputs to source signal-line S_a-S_d.

[0195] Although this example described the technique of sampling simultaneously the signal corresponding to a four source signal line using the quadrisected video signal, generally you may sample simultaneously the signal corresponding to a n source signal line using the digital signal of which n division was done.

[0196] The detailed composition of a latch (A) and (8802) is explained taking the case of a part of latch (A) corresponding to source signal-line S_a, and (8802). [8804] A part of latch (A) and (8802) have two clocked inverters and two inverters. [8804]

[0197] Some [8804] plans of a latch (A) and (8802) are shown in drawing 7 . 831a and 831b are the barrier layers of TFT which forms one of the inverters which a part of latch (A) and (8802) have, respectively, and 836 is the common gate electrode of TFT which forms one of

the inverters of these. [8804] Moreover, 832a and 832b are the barrier layers of TFT which forms another inverter which a part of latch (A) and (8802) have, respectively, and 837a and 837b are the gate electrodes prepared on barrier-layer 832a and 832b, respectively. [8804] In addition, the gate electrodes 837a and 837b are connected electrically.

[0198] 833a and 833b are the barrier layers of TFT which forms one of the clocked inverters which a part of latch (A) and (8802) have, respectively. [8804] On barrier-layer 833a, the gate electrodes 838a and 838b are formed, and it has double-gate structure. Moreover, the gate electrodes 838b and 839 are formed on barrier-layer 833b, and it has double-gate structure.

[0199] 834a and 834b are the barrier layers of TFT which forms another clocked inverter which a part of latch (A) and (8802) have, respectively. [8804] The gate electrodes 839 and 840 are formed on barrier-layer 834a, and it has double-gate structure. Moreover, the gate electrodes 840 and 841 are formed on barrier-layer 834b, and it has double-gate structure.

[0200] (Example 9) this example explains the example which produced EL display which uses the drive method of this invention using drawing 15 (A) and (B). Drawing 15 (A) is the plan showing the state where it carried out to enclosure of an EL element in the active-matrix substrate in which the EL element was formed. As for a source signal-line drive circuit and 6802, 6801 shown by the dotted line is [a gate signal line drive circuit and 6803] the pixel sections. Moreover, between the inside covering material and active-matrix substrates by which the 1st sealant and 6806 are the 2nd sealant and were surrounded by the 1st sealant 6805, as for 6804, a filler 6807 (refer to drawing 15 (B)) is formed, as for covering material and 6805.

[0201] In addition, 6808 is connection wiring for transmitting the signal inputted into the source signal-line drive circuit 6801, the gate signal line drive circuit 6802, and the pixel section 6803, and receives a video signal and a clock signal from FPC (flexible print circuit) 6809 which serves as an end-connection child with an external instrument.

[0202] Here, the cross section equivalent to the cross section which cut drawing 15 (A) by A-A' is shown in drawing 15 (B). In addition, the same sign is used for the same part in drawing 15 (A) and (B).

[0203] As shown in drawing 15 (B), on the substrate 6800, the pixel section 6803 and the source side drive circuit 6801 are formed, and the pixel section 6803 is formed in TFT6851 (henceforth TFT for EL drive) and its drain field for controlling the current which flows to an EL element of two or more pixels containing the pixel electrode 6852 grade connected electrically. TFT6851 for EL drive is set to p-channel type TFT in this example. Moreover, the source signal-line drive circuit 6801 is formed using the CMOS circuit which combined n channel type TFT6853 and p-channel type TFT6854 complementary.

[0204] each -- a pixel -- a pixel -- an electrode -- the bottom -- a light filter -- (-- R --) -- 6855 -- a light filter -- (-- G --) -- 6856 -- and -- a light filter -- (-- B --) -- (-- not illustrating --) -- having -- **** . A light filter (R) is a light filter which extracts red light, and the light filter from which a light filter (G) extracts green light, and a light filter (B) are light filters which extract a blue glow here. In addition, a light filter (G) 6856 is formed in the pixel of green luminescence, and a light filter (R) 6855 is formed for a light filter (B) in the pixel of red luminescence at the pixel of blue luminescence.

[0205] As an effect at the time of preparing these light filters, the point that the color purity of the luminescent color improves first is mentioned. for example, red light emanates from the EL element from the pixel of red luminescence -- having (it emanating toward a pixel electrode side in this example) -- red purity can be raised by letting this red light pass to the light filter which extracts red light In the case of other green light and a blue glow, this is the same.

[0206] Moreover, with the structure where the conventional light filter is not used, the light which invaded from the outside of EL display excites the luminous layer of an EL element, and the problem from which desired coloring is not obtained may arise. However, only the light of specific wavelength ceases to go into an EL element by preparing a light filter like this example. That is, it is possible to prevent fault an EL element will be excited by the light from the outside.

[0207] In addition, although the conventional proposal of the structure of preparing a light filter was made, the EL element used the thing of white luminescence. In this case, since the light of other wavelength was cut for extracting red light, the fall of brightness had been caused. It seems that however, the fall of brightness is not caused in this example in order to let the red light emitted, for example from the EL element pass to the light filter which extracts red light.
[0208] Next, the pixel electrode 6852 is formed by the transparent electric conduction film, and functions as an anode plate of an EL element. Moreover, an insulator layer 6857 is formed in the ends of the pixel electrode 6852, and the luminous layer 6858 which emits light in red further, and the luminous layer 6859 which emits light green are formed. In addition, although not illustrated, the luminous layer which emits light blue is prepared in the adjoining pixel, and color display is performed to it by the pixel corresponding to red, green, and blue. Of course, the light filter from which the pixel in which the blue luminous layer was prepared extracts blue is prepared.
[0209] In addition, not only an organic material but inorganic material can be used as an EL material. Moreover, it is good also as a laminated structure which combined not only a luminous layer but an electron-injection layer, an electronic transporting bed, an electron hole transporting bed, and a hole-injection layer.
[0210] Moreover, on each luminous layer, the cathode 6860 of an EL element is had and formed by the electric conduction film which has shading nature. This cathode 6860 is common to all pixels, and is electrically connected to FPC6809 via the connection wiring 6808.
[0211] Next, the 1st sealant 6805 is formed by the dispenser etc., a spacer (not shown) is sprinkled, and the covering material 6804 is stuck. And it is filled up with a filler 6807 by the vacuum pouring-in method in the active-matrix substrate 6800 and the field which reached covering material 6804 and was surrounded by the 1st sealant 6805.
[0212] Moreover, in this example, the barium oxide is beforehand added as hygroscopic matter 6861 to the filler 6807. In addition, although the hygroscopic matter is added and used for a filler in this example, it can be made to be able to distribute massive and can also enclose into a filler. Moreover, although not illustrated, it is also possible to use the hygroscopic matter as a material of a spacer.
[0213] Next, after stiffening a filler 6807 by UV irradiation or heating, opening (not shown) formed in the 1st sealant 6805 is plugged up. If opening of the 1st sealant 6805 is plugged up, the connection wiring 6808 and FPC6809 will be electrically connected using the conductive material 6862. Furthermore, the 2nd sealant 6806 is formed so that the disclosure section of the 1st sealant 6805 and a part of FPC6809 may be covered. The 2nd sealant 6806 should just use the same material as the 1st sealant 6805.
[0214] By enclosing an EL element with a filler 6807 using the above methods, an EL element can be completely intercepted from the outside and it can protect from the exterior that the matter to which oxidization of organic materials, such as moisture and oxygen, is urged invades. Therefore, reliable EL display is producible.
[0215] (Example 10) this example shows the example at the time of changing arrangement of the direction of a light emission and light filter which are emitted from an EL element in EL display shown in the example 9. Although drawing 16 is used for explanation, since fundamental structure is the same as that of drawing 15 (B), it attaches and explains a new sign to a change portion.
[0216] The pixel section 6901 is [0217] formed in TFT6902 (henceforth TFT for EL drive) and its drain field for controlling the current which flows to an EL element of two or more pixels containing the pixel electrode 6903 grade connected electrically. In this example, n channel type TFT is used for the pixel section 6901 as TFT6902 for EL drive. Moreover, the pixel electrode 6903 is electrically connected to the drain of TFT6902 for EL drive, and this pixel electrode 6903 is formed by the electric conduction film which has shading nature. In this example, the pixel electrode 6903 turns into cathode of an EL element.
[0218] Moreover, on the luminous layer 6858 which emits light in red, and the luminous layer

6859 which emits light green, the transparent electric conduction film 6904 common to each pixel is formed. This transparent electric conduction film 6904 serves as an anode plate of an EL element.
[0219] furthermore — this example — **** — a light filter — (— R —) — 6905 — a light filter — (— G —) — 6906 — and — a light filter — (— B —) — (— not illustrating —) — covering — material — 6804 — forming — having — **** — a point — the feature — it is . Since the direction of a light emission emitted from the luminous layer goes to a covering material side when it considers as the structure of the EL element of this example, a light filter can be installed in the structure of drawing 16 , then the path of the light.
[0220] this example — like — a light filter — (— R —) — 6905 — a light filter — (— G —) — 6906 — and — a light filter — (— B —) — (— not illustrating —) — covering — material — 6804 — preparing — if — an active matrix — a substrate — a process — few — it can carry out — the yield — and — a throughput — improvement — it can plan — ** — saying — an advantage — it is .
[0221] (Example 11) In EL display using the drive method of this invention, the material used for EL layer which an EL element has is not limited to organic EL material, but even if it uses inorganic EL material, it can be carried out. However, since driver voltage is very high, the present inorganic EL material must use TFT which has the proof-pressure property that such driver voltage can be borne.
[0222] Or if the low inorganic EL material of driver voltage will be developed further in the future, applying to this invention is possible.
[0223] (Example 12) In EL display using the drive method of this invention, even if the organic substance used as an EL layer is a low-molecular system organic substance, it may be a polymer system (macromolecule system) organic substance. The material [organic substance / low-molecular system] consisting mainly of Alq3 (tris-8-kino rewrite-aluminum), TPD (triphenylamine derivative), etc. is known. The matter of pi conjugate polymer system is mentioned as a polymer system organic substance. Typically, PPV (polyphenylene vinylene), PVK (polyvinyl carbazole), a polycarbonate, etc. are mentioned.
[0224] A polymer system (macromolecule system) organic substance can be formed by the simple thin film formation methods, such as the spin coating method (it is also called the solution applying method), a dipping method, the dispensing method, print processes, or the ink-jet method, and its thermal resistance is high compared with a low-molecular system organic substance.
[0225] Moreover, in the EL element which EL display has, when EL layer which the EL element has has the electronic transporting bed and the electron hole transporting bed, it may constitute an electronic transporting bed and an electron hole transporting bed from amorphous semiconductors, such as an inorganic material, for example, amorphous Si, or amorphous Si1-xCx.
[0226] A lot of interface level is formed in the interface to which a lot of trap levels exist in an amorphous semiconductor, and an amorphous semiconductor touches other layers. Therefore, an EL element can also attain high brightness-ization while being able to make it emit light on low voltage.
[0227] Moreover, a dopant (impurity) may be added in organic EL layer, and the color of luminescence of organic EL layer may be changed. As a dopant, DCM1, the Nile red, rubrene, a coumarin 6, TPB, a Quinacridone, etc. are mentioned.
[0228] (Example 13) this example explains the electronic equipment which incorporated EL display which uses the drive method of this invention as a display medium.
[0229] As such electronic equipment, a video camera, a digital camera, a head mount display (goggles type display), a game machine, car navigation, a personal computer, Personal Digital Assistants (a mobile computer, a cellular phone, or digital book), etc. are mentioned. Those examples are shown in drawing 18 .
[0230] Drawing 18 (A) is a personal computer and contains a main part 2001, a case 2002, a display 2003, and keyboard 2004 grade. EL display using the drive method of this invention can be used for the display 2003 of a personal computer.

[0231] Drawing 18 (B) is a video camera and contains a main part 2101, a display 2102, the voice input section 2103, the operation switch 2104, a dc-battery 2105, and television section 2106 grade. EL display using the drive method of this invention can be used for the display 2102 of a video camera.
[0232] Drawing 18 (C) is some head installation type (head mount display) display (right one side), and contains a main part 2301, a signal cable 2302, the head fixed band 2303, the display monitor 2304, optical system 2305, and display 2306 grade. EL display using the drive method of this invention can be used for the display 2306 of head installation type display.
[0233] Drawing 18 (D) is the picture reproducer (specifically DVD regenerative apparatus) equipped with the record medium, and contains a main part 2401, record media (CD, LD, or DVD) 2402, the operation switch 2403, a display (a) 2404, and (Display b) 2405 grade. a display -- (-- a --) -- mainly -- image information -- displaying -- a display -- (-- b --) -- mainly -- alphabetic information -- displaying -- although -- this invention -- a drive -- a method -- using -- EL -- display -- a record medium -- having had -- a picture reproducer -- a display -- (-- a --) -- 2404 -- (-- b --) -- 2405 -- it can use . In addition, this invention can be used for CD regenerative apparatus, a game machine machine, etc. as a picture reproducer equipped with the record medium.
[0234] Drawing 18 (E) is a carried type (mobile) computer, and contains a main part 2501, the camera section 2502, the television section 2503, the operation switch 2504, and display 2505 grade. EL display using the drive method of this invention can be used for the display 2505 of a carried type (mobile) computer.
[0235] As mentioned above, the scope of this invention is very wide, and applying to the electronic equipment of all fields is possible. Moreover, even if the electronic equipment of this example uses the composition which consists of combination like an example 1 - 12 throats, it is realizable.
[0236]
[Effect of the Invention] In active-matrix type EL display, there was a problem that variation arose [the amount of current which flows an EL element by change of the variation in the property of TFT of the pixel section and the environmental temperature at the time of using it] in a brightness display for a rose **** reason, by the conventional gradation means of displaying.
[0237] However, by the above-mentioned composition, this invention can keep constant the current which flows to a pixel section EL element to a temperature change, and can suppress the variation in a display. Thereby, the drive method of EL display in which a high-definition display is possible can be offered.

[Translation done.]

TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the drive method of the electronic display which made EL (electroluminescence) element on the substrate and was formed. It is related with the drive method of EL display especially using the semiconductor device (element using the semiconductor thin film). Moreover, it is related with the electronic equipment which used EL display for the display.

[0002] In addition, in this specification, although an EL element uses luminescence (phosphorescence) from a triplet exciton, it shall indicate both to be the things using luminescence (fluorescence) from a singlet exciton.

[Translation done.]

PRIOR ART

[Description of the Prior Art] In recent years, development of EL display with the EL element is activating as a spontaneous light type element. EL display is also called the organic EL display (OELD:Organic EL Display) or organic light emitting diode (OLED:Organic Light EmittingDiode).

[0004] Unlike a liquid crystal display, EL display is a spontaneous light type. Although the EL element has the structure where EL layer was pinched between the electrodes (an anode plate and cathode) of a couple, EL layer usually has a laminated structure. Typically, the laminated structure "the electron hole transporting bed / luminous layer / electronic transporting bed" which Tang and others of KODAKKU Eastman Company proposed is mentioned. This structure has very high luminous efficiency, and most EL display with which research and development are furthered has adopted this structure now.

[0005] Moreover, otherwise, the structure which carries out a laminating to the order of a hole-injection layer / electron hole transporting bed / luminous layer / electronic transporting bed on an anode plate, or the structure which carries out a laminating to the order of a hole-injection layer / electron hole transporting bed / luminous layer / electronic transporting bed / electron-injection layer is sufficient. You may dope fluorescence nature coloring matter etc. to a luminous layer.

[0006] All the layers prepared between cathode and an anode plate in this specification are named generically, and it is called EL layer. Therefore, all of the hole-injection layer mentioned above, an electron hole transporting bed, a luminous layer, an electronic transporting bed, an electron-injection layer, etc. are contained in EL layer.

[0007] And predetermined voltage is applied to EL layer which becomes with the above-mentioned structure between the electrodes (two electrodes) of a couple, and thereby, in a luminous layer, the reunion of a carrier happens and light is emitted. In addition, if an EL element drives that an EL element emits light in this specification, it will be called.

[0008] Active-matrix type EL display is mentioned as the drive method of EL display.

[0009] The example of the composition of the pixel section of active-matrix type EL display is shown in drawing 3 . The gate signal line (G1-Gy) which inputs a selection signal from a gate signal line drive circuit is connected to the gate electrode of TFT301 for switching which each pixel has. Moreover, the source field and drain field of TFT301 for switching which each pixel has are connected to one electrode of the capacitor 303 which the gate electrode and each pixel of TFT302 for EL drive have [another side] at the source signal line (S1-Sx) into which one side inputs a signal from a source signal-line drive circuit. Another electrode of a capacitor 303 is connected to the current supply line (V1-Vx). It connects with one electrode of EL element 304 to which, as for one side of the source field of TFT302 for EL drive, and a drain field which each pixel has, each pixel has another side on a current supply line (V1-Vx).

[0010] EL element 304 has EL layer prepared between an anode plate, cathode, and an anode plate and cathode. When the anode plate of EL element 304 has connected with the source field of TFT302 for EL drive, or a drain field, the anode plate of EL element 304 turns into a pixel electrode, and cathode turns into a counterelectrode. On the contrary, when the cathode of EL element 304 has connected with the source field of TFT302 for EL drive, or a drain field, the cathode of EL element 304 turns into a pixel electrode, and an anode plate turns into a

counterelectrode.
[0011] In addition, in this specification, the potential of a counterelectrode is called opposite potential. In addition, the power supply which gives opposite potential to a counterelectrode is called opposite power supply. The potential difference of the potential of a pixel electrode and the potential of a counterelectrode is EL driver voltage, and this EL driver voltage is impressed to EL layer.
[0012] As the gradation method of presentation of the above-mentioned EL display, an analog gradation method and a time gradation method are held.
[0013] First, the analog gradation method of EL display is explained. The timing chart at the time of driving the display shown by drawing 3 by the analog gradation method is shown in drawing 4 . A period after one gate signal line is chosen until the following gate signal line is chosen is called one-line period (L). Moreover, a period after one picture is chosen until the following picture is chosen is equivalent to an one-frame period. Since there are y gate signal lines in the case of EL display of drawing 3 , y line periods (L1-Ly) are prepared during one frame.
[0014] The number of the line periods in an one-frame period also increases, and it must stop having to drive a drive circuit on high frequency as resolution becomes high.
[0015] The current supply line (V1-Vx) is maintained at fixed potential (power supply potential). Moreover, opposite potential is also kept constant. Opposite potential has the potential difference between power supply potentials in the grade to which an EL element emits light.
[0016] In the 1st line period (L1), the selection signal from a gate signal line drive circuit is inputted into the gate signal line G1. And the video signal of an analog is inputted into a source signal line (S1-Sx) in order.
[0017] Since all TFT301 for switching connected to the gate signal line G1 will be in the state of ON, the video signal of the analog inputted into the source signal line (S1-Sx) is inputted into the gate electrode of TFT302 for EL drive through TFT301 for switching.
[0018] TFT301 for switching is turned on and the gate voltage of TFT302 for EL drive changes with the potentials of the video signal of the analog inputted in the pixel. At this time, drain current is decided by 1 to 1 to a gate voltage according to the Id-Vg property of TFT302 for EL drive. That is, corresponding to the potential of the video signal of the analog inputted into the gate electrode of TFT302 for EL drive, the potential (EL drive potential of ON) of a drain field becomes settled, predetermined drain current flows to an EL element, and the aforementioned EL element emits light in the amount of luminescence corresponding to the amount of current.
[0019] After repeating operation mentioned above and completing the input of the video signal of the analog to a source signal line (S1-Sx), the 1st line period (L1) expires. In addition, it is good also considering a period and a horizontal-retrace-line period until the input of the video signal of the analog to a source signal line (S1-Sx) is completed as one line period in all. And next the 2nd line period (L2) comes, and a selection signal is inputted into the gate signal line G2. And the video signal of an analog is inputted into a source signal line (S1-Sx) in order like the 1st line period (L1).
[0020] And if a selection signal is inputted into all gate signal lines (G1-Gy), all line periods (L1-Ly) will expire. An end of all line periods (L1-Ly) terminates an one-frame period. All pixels display during one frame and one picture is formed. In addition, it is good also considering all line periods (L1-Ly) and vertical-retrace-line periods as an one-frame period in all.
[0021] As mentioned above, the amount of luminescence of an EL element is controlled by the video signal of an analog, and a gradation display is made by control of the amount of luminescence. Thus, a gradation display is performed by the analog gradation method by change of the potential of the video signal of the analog inputted into a source signal line.
[0022] Next, a time gradation method is explained.
[0023] By the time gradation method, a digital signal is inputted into a pixel, the luminescence state or the state where light is not emitted of an EL element is chosen, and the accumulating

totals of the period when the EL element emitted light to around the one-frame period express gradation.

[0024] Here, when expressing 2n (n is the natural number) gradation, it attaches and explains. The timing chart at the time of driving the display shown by drawing 3 by this time gradation method is shown in drawing 5 . First, an one-frame period is divided during [n] the subframe (SF1-SFn). In addition, all the pixels of the pixel section call the period which displays one picture one-frame period (F). Moreover, the period which divided the one-frame period into plurality further is called subframe period. The number of partitions of an one-frame period must also increase as the number of gradation increases, and you have to drive a drive circuit on high frequency.

[0025] One subframe period is divided into a write-in period (Ta) and a display period (Ts). A write-in period is a period which inputs a digital signal into all pixels during the 1 subframe, with the inputted digital signal, an EL element will be in luminescence or the state where light is not emitted, and the display period (it is also called a lighting period) shows the period which displays.

[0026] Moreover, EL driver voltage shown in drawing 5 expresses EL driver voltage of the EL element which had the luminescence state chosen. That is, EL driver voltage (drawing 5) of the EL element which had the luminescence state chosen is set to 0V during a write-in period, and it has the size which is the grade to which an EL element emits light during a display period.

[0027] Opposite potential is controlled by the external switch (not shown), and opposite potential is maintained at the almost same height as power supply potential in a write-in period, and has the potential difference which is the grade to which an EL element emits light between power supply potentials in a display period.

[0028] First, the write-in period and display period which each subframe period has are explained in detail using drawing 3 and drawing 5 , and a time gradation display is explained after that.

[0029] A gate signal is first inputted into the gate signal line G1, and all TFT301 for switching connected to the gate signal line G1 will be in the state of ON. And a digital signal is inputted into a source signal line (S1-Sx) in order. Opposite potential is maintained at the same height as the potential (power supply potential) of a current supply line (V1-Vx). The digital signal has the information on "0" or "1." The digital signal of "0" and "1" means the signal which has the voltage of either Hi or Lo, respectively.

[0030] And the digital signal inputted into the source signal line (S1-Sx) is inputted into the gate electrode of TFT302 for EL drive through TFT301 for switching of the state of ON. Moreover, a digital signal is inputted also into a capacitor 303 and it is held.

[0031] And the digital signal which operation mentioned above in inputting a gate signal into the gate signal lines G2-Gy in order was repeated, and the digital signal was inputted into all pixels, and was inputted in each pixel is held. A period until a digital signal is inputted into all pixels is written in, and it is called a period.

[0032] If a digital signal is inputted into all pixels, all TFT301 for switching will be in the state of OFF. And opposite potential changes with the external switches (not shown) connected to the counterelectrode so that it may have the potential difference which is the grade to which EL element 304 emits light between power supply potentials.

[0033] When the digital signal has the information on "0", TFT302 for EL drive will be in the state of OFF, and EL element 304 will not emit light. On the contrary, when it has the information on "1", TFT302 for EL drive will be in the state of ON. As a result, the pixel electrode of EL element 304 is kept almost equal to power supply potential, and EL element 304 emits light. Thus, the luminescence state or the state where light is not emitted of an EL element is chosen by the information which a digital signal has, and all pixels display all at once using it. A picture is formed when all pixels display. The period when a pixel displays is called display period.

[0034] All the length of the write-in period (Ta1-Tan) which it has, respectively has n the same subframe periods (SF1-SFn). SF1-SFn set to Ts1-Tsn the display period (Ts) which it

has, respectively, respectively.
[0035] The length of a display period is [— It sets up so that it may become :2-(n-2):2- (n-1).] Ts1:Ts2:Ts3. : — It is :Ts(n-1):Tsn=20:2-1:2-2. : A desired gradation display can be performed among 2n gradation in the combination of this display period.
[0036] Display periods are one to Ts1-Tsn of periods. Here, it carries out to having made the predetermined pixel of Ts1 turn on during the period.
[0037] Next, it enters again in a write-in period, and if a data signal is inputted into all pixels, it will enter during the display. At this time, the period of either Ts2-Tsn turns into a display period. Here, it carries out to having made the predetermined pixel of Ts2 turn on during the period.
[0038] The operation same about the n-2 remaining subframes is repeated hereafter, and it is Ts3 and Ts4 one by one. — Tsn and a display period are set up and it carries out to having made the pixel predetermined by each subframe turn on.
[0039] When n subframe periods appear, it means finishing an one-frame period. At this time, the gradation of the pixel is decided by integrating the length of the display period which the pixel had turned on. For example, when brightness when a pixel emits light in all display periods was made into 100% at the time of n= 8 and a pixel emits light in Ts1 and Ts2, 75% of brightness can be expressed, and when Ts3, and Ts5 and Ts8 are chosen, 16% of brightness can be expressed.
[0040] In addition, in the drive method of a time [to input a n-bit digital signal and express gradation] gradation method, the length of the number of partitions or each subframe period at the time of dividing an one-frame period during [two or more] the subframe etc. is not limited above.

[Translation done.]

* NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

EFFECT OF THE INVENTION

[Effect of the Invention] In active-matrix type EL display, there was a problem that variation arose [the amount of current which flows an EL element by change of the variation in the property of TFT of the pixel section and the environmental temperature at the time of using it] in a brightness display for a rose **** reason, by the conventional gradation means of displaying.
[0237] However, by the above-mentioned composition, this invention can keep constant the current which flows to a pixel section EL element to a temperature change, and can suppress the variation in a display. Thereby, the drive method of EL display in which a high-definition display is possible can be offered.

[Translation done.]

* NOTICES *

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] The trouble in the case of using the analog gradation method shown in the conventional example is listed to a degree.
[0042] By the analog gradation method, there is a trouble that the variation in the property of TFT influences a gradation display greatly. For example, the case where it differs by two pixels as which the Id-Vg property of TFT for switching expresses the same gradation is assumed (when the property of one of pixels shifts to a plus or minus side on the whole to another side).
[0043] In this case, the drain current of each TFT for switching serves as a different value, and the gate voltage of a different value will be impressed to TFT for EL drive of each pixel. The current of a different amount to each EL element flows, it becomes the different amount of luminescence as a result, and it becomes impossible that is, to express the same gradation.

[0044] Moreover, though a gate voltage equal to TFT for EL drive of each pixel is impressed, if variation is in the Id-Vg property of TFT for EL drive, the same drain current cannot be outputted. Therefore, if it differs even when Id-Vg properties are few, even if an equal gate voltage is impressed, the situation of differing greatly may produce the amount of current outputted. Then, with variations in few Id-Vg properties, even if it inputs the signal of the same voltage, the amount of luminescence of an EL element will change greatly by the contiguity pixel.
[0045] In fact, since it becomes the synergistic effect of both variation of TFT for switching, and TFT for EL drive, a gradation display will be rose ****** still more greatly. Thus, the analog gradation display is very sensitive to the property variation of TFT. Therefore, when this EL display performs a gradation display, that the display has much nonuniformity poses a problem.
[0046] Next, the trouble in the case of using a time gradation method is mentioned.
[0047] The brightness of an EL element is expressed by the time gradation method by the time when current was flowing and emitting light to the EL element. Therefore, the display nonuniformity by the property variation of TFT which became a problem in the above-mentioned analog gradation method is stopped sharply. However, there is another problem.
[0048] The current which flows to an EL element is controlled by voltage (EL driver voltage) impressed between the two electrodes of an EL element. This EL driver voltage is the voltage which deducted the voltage between the drain sources of TFT for EL drive from the potential difference of power supply potential and opposite potential. In order to avoid the influence of the variation in the voltage between the drain sources by the variation in the property of TFT for EL drive and to keep this EL driver voltage constant, the voltage between the drain sources of TFT for EL drive is small set up for whether being ** compared with EL driver voltage. At this time, TFT for EL drive is operating in the alignment field.
[0049] In TFT operation, it is equivalent to an active region when the voltage VDS between the drain sources of TFT is smaller than the gate voltage VGS of TFT with a line type field.
[0050] Here, the current which flows between the two electrodes of an EL element is influenced with temperature. Drawing 17 is a graph which shows the temperature characteristic of an EL element. The amount of current which flows between the two

electrodes of an EL element with this graph to the voltage impressed between the two electrodes of an EL element to the bottom of a certain temperature can be known. Temperature T1 is higher than temperature T2, and that of temperature T2 is higher than temperature T3. A bird clapper understands between the two electrodes of an EL element for the flowing current greatly, so that it will become high if the temperature of EL layer becomes high by the temperature characteristic which an EL element has even if the voltage impressed between the two electrodes of the EL element of the pixel section is the same.

[0051] Moreover, the brightness of an EL element is proportional to the amount of current which flows between the two electrodes of an EL element.

[0052] Thus, it is a problem that change the current which will flow between the two electrodes of an EL element even if it is continuing applying fixed voltage between the two electrodes of an EL element, brightness changes, and an exact gradation display becomes impossible by change of the environmental temperature which uses EL display.

[0053] In active-matrix type EL display, when using an analog gradation method like before, and a time gradation method, an exact gradation display cannot be performed for the reason mentioned above. Then, the exact gradation display of this invention is enabled, and it makes it a technical problem to offer the drive method of EL display in which a high-definition display is possible.

[Translation done.]

MEANS

[Means for Solving the Problem] this invention drives active-matrix type EL display with a time gradation method. At this time, TFT for EL drive is operated by the saturation region, and it is characterized by keeping drain current constant to a temperature change.
[0055] The current which flows between the two electrodes of an EL element can be kept constant to the variation in the property of TFT, and change of environmental temperature by this, an exact gradation display is possible and the drive method of EL display in which a high-definition display is possible can be offered.
[0056] The composition of this invention is shown below.
[0057] By this invention, have the pixel which has an EL element and a transistor, respectively, divide an one-frame period during [two or more] the subframe, and it sets during [two or more / each] the aforementioned subframe. If the 1st gate voltage or the 2nd gate voltage is impressed to the gate electrode of the aforementioned transistor and the 1st gate voltage of the above is impressed to the gate electrode of the aforementioned transistor If the drain current of the aforementioned transistor flows between the two electrodes of the aforementioned EL element, the aforementioned EL element will be in a luminescence state and the 2nd gate voltage of the above is impressed to the gate electrode of the aforementioned transistor The aforementioned transistor will be in non-switch-on, the aforementioned EL element is the drive method of the display which will be in the state where light is not emitted, and the drive method of the display characterized by the absolute value of the 1st gate voltage of the above being below an absolute value of the voltage between the drain sources of the aforementioned transistor is offered.
[0058] By this invention, have the pixel which has an EL element, a transistor, and resistance, respectively, divide an one-frame period during [two or more] the subframe, and it sets during [two or more / each] the aforementioned subframe. If the 1st gate voltage or the 2nd gate voltage is impressed to the gate electrode of the aforementioned transistor and the 1st gate voltage of the above is impressed to the gate electrode of the aforementioned transistor If the drain current of the aforementioned transistor flows between the two electrodes of the aforementioned resistance and the aforementioned EL element, the aforementioned EL element will be in a luminescence state and the 2nd gate voltage of the above is impressed to the gate electrode of the aforementioned transistor The aforementioned transistor will be in non-switch-on, the aforementioned EL element is the drive method of the display which will be in the state where light is not emitted, and the drive method of the display characterized by the absolute value of the 1st gate voltage of the above being below an absolute value of the voltage between the drain sources of the aforementioned transistor is offered.
[0059] The more the ratio to the gate length of gate width of the aforementioned transistor is smaller than 1, the more the absolute value of the 1st gate voltage of the above impressed to the gate electrode of the aforementioned transistor may be the drive method of the display characterized by the large thing in the range which does not exceed the absolute value of the voltage between the drain sources of the aforementioned transistor.
[0060] The aforementioned EL element may be the drive method of the display characterized by making color display possible combining a color conversion layer using EL layer which carries out monochrome luminescence.

[0061] The aforementioned EL element may be the drive method of the display characterized by making color display possible combining a light filter using EL layer which carries out white luminescence.
[0062] EL layer of the aforementioned EL element may be the drive method of the display characterized by being a low-molecular system organic substance or a polymer system organic substance.
[0063] The aforementioned low-molecular system organic substance may be the drive method of the display characterized by the bird clapper from Alq3 (tris-8-kino rewrite-aluminum) or TPD (triphenylamine derivative).
[0064] The aforementioned polymer system organic substance may be the drive method of the display characterized by the bird clapper from PPV (polyphenylene vinylene), PVK (polyvinyl carbazole), or a polycarbonate.
[0065] EL layer of the aforementioned EL element may be the drive method of the display characterized by being a mineral matter.
[0066] You may be the video camera characterized by using the drive method of the aforementioned display, a picture reproducer, a head mount display, a cellular phone, or a Personal Digital Assistant.
[0067]
[Embodiments of the Invention] The gestalt of operation of this invention is explained using drawing 1.
[0068] Drawing 1 (A) shows the composition of the pixel of EL display of this invention. The gate electrode of TFT903 for switching is connected to the gate signal line 906. One side is connected to the source signal line 905, and another side is connected to the gate electrode and capacitor 904 of TFT900 for EL drive for the source field and drain field of TFT903 for switching. One side is connected to the current supply line 902, and another side is connected to the anode plate or cathode of EL element 901 for the source field and drain field of TFT900 for EL drive.
[0069] Voltage (gate voltage) impressed between the gate sources of TFT900 for EL drive from TFT903 for switching is set to VGS. Moreover, voltage (voltage between the drain sources) given between the drain sources of TFT900 for EL drive is set to VDS, and the current (drain current) which flows between the drain sources at this time is set to ID. This drain current ID is inputted into EL element 901. Moreover, if voltage (EL driver voltage) impressed between the two electrodes of EL element 901 is set to VEL, the voltage VIN impressed to the pixel section (counterelectrode of an EL element) from the current supply line 902 will be given by the sum of the voltage VDS between the drain sources, and the EL driver voltage VEL.
[0070] Here, the relation between the voltage VDS between the drain sources and drain current ID is shown in a graph at drawing 1 (B). The gate voltage VGS is fixed. In this graph, the field where drain current ID corresponds by 1 to 1 to the voltage VDS between the drain sources is called line type field, and the voltage VDS between the drain sources corresponds, when small compared with a gate voltage VGS. Moreover, drain current ID calls the field of simultaneously regularity a saturation region to the voltage VDS between the drain sources. This corresponds, when the voltage VDS between the drain sources is more than gate-voltage VGS.
[0071] It was controlling by the drive method of EL display by the conventional time gradation method so that the voltage impressed between the two electrodes of an EL element became fixed. At this time, the voltage VDS between the drain sources of TFT for EL drive will affect the EL driver voltage VEL with rose **** by the variation in the property of TFT. Then, in order to suppress the influence of this variation as much as possible, the voltage VDS between the drain sources of TFT for EL drive is small set up to the EL driver voltage VEL, and the great portion of voltage VIN inputted into a pixel is made to be impressed between the two electrodes of an EL element. Therefore, TFT for EL drive was operated in the line type field in which the voltage VDS between the drain sources corresponds when small compared with a gate voltage VGS.

[0072] It is made to operate with EL display of this invention by the saturation region which sets up the voltage VDS between the drain sources of TFT900 for EL drive more than gate-voltage VGS, and is not concerned with the voltage VDS between the drain sources in TFT900 for EL drive, but passes fixed drain current ID. By this, it will not be based on a temperature change but fixed current will always be supplied to an EL element.
[0073] The example value of voltage inputted into an EL element and TFT for EL drive is shown below.
[0074] For example, threshold voltage of TFT for EL drive is made into about 2V. Here, in the pixel which had the luminescence state of an EL element chosen, when the gate voltage VGS of TFT for EL drive is set to 5V, voltage between the counterelectrodes of an EL element and current supply lines in a display period (difference of opposite potential and power supply potential) is made into about 15V. At this time, the voltage VEL between the two electrodes of an EL element takes an about [5-10V] value, and the voltage VDS between the drain sources of TFT for EL drive becomes more than 5V. At this time, the voltage VDS between the drain sources of TFT for EL drive becomes more than gate-voltage VGS, and TFT for EL drive operates by the saturation region.
[0075] Thereby, to an EL element, it will not be based on a temperature change, but fixed current will always flow, and light is emitted by fixed brightness to it.

[Translation done.]

* NOTICES *

EXAMPLE

[Example] Below, the example of this invention is explained.
[0077] (Example 1) In the technique of keeping constant the current ID which TFT for EL drive stated with the gestalt of implementation of invention is operated by the saturation region, and flows between the two electrodes of an EL element, this example describes how to suppress the influence of the variation in the property of TFT for EL drive. The same sign as the sign used in drawing 1 (A) and the sign added newly are used for explanation.
[0078] When operating TFT900 for EL drive by the saturation region, the formula 1 shown below is materialized.
[0079]
[Formula 1] ID=alpha (VGS-Vth) 2 (W/L) [0080] For a gate voltage and Vth, in a formula 1, threshold voltage and W are [ID / drain current and VGS / gate length and alpha of gate width and L] constants. Here, since the threshold voltage Vth has variation, drain current ID will have variation.
[0081] then, a ratio [on the range which operates by the saturation region in order to suppress this variation, and as opposed to gate-length L of gate width W] — W/L is made small and a gate voltage VGS is enlarged Thereby, the variation in the drain current ID by the variation in the threshold voltage Vth of TFT900 for EL drive can be suppressed.
[0082] For example, the threshold voltage Vth takes the value of 2**0.1V, and presupposes that it has 5% of variation. When W/L is set to 8, a gate voltage VGS is set to 3V. When the value of drain current ID is calculated at this time, it will have about 20% of variation. Here, the average of drain current ID presupposes that it is I0. On the other hand, if W/L is set to 0.5, in order to make the average I0 of drain current ID the same as the case where W/L is 8, it is necessary to set a gate voltage VGS to about 6 V. It will be stopped by about 5% of variation if the value of drain current ID is calculated when a gate voltage VGS is 6V.
[0083] Thus, it is good to make W/L or less into 0.5 desirably less than one.
[0084] (Example 2) In the technique of keeping constant the current ID which TFT for EL drive stated with the gestalt of implementation of invention is operated by the saturation region, and flows between the two electrodes of an EL element, by this example, it is the method of being different in an example 1, and how to suppress the influence of the variation in the property of TFT for EL drive is stated.
[0085] The composition of the pixel section of the display of this example is shown in drawing 2 . Since fundamental structure is the same as that of drawing 1 (A), it attaches and explains a sign which is different into a change portion.
[0086] The gate electrode of TFT903 for switching is connected to the gate signal line 906. One side is connected to the source signal line 905, and another side is connected to the gate electrode of TFT900 for EL drive, and one electrode of a capacitor 904 for the source field and drain field of TFT903 for switching. Another electrode of a capacitor 904 is connected to the current supply line 902. One side is connected to the current supply line 902 through resistance 907, and another side is connected to the anode plate or cathode of EL element 901 for the source field and drain field of TFT900 for EL drive.
[0087] In the composition of the pixel of this example, the formula 1 shown in the example 1 and the formula 2 shown below are materialized simultaneously.

[0088]
[Formula 2] V=VGS+RID [0089] Here, V is the potential difference given between the gate electrode of TFT900 for EL drive, and the current supply line 902. Moreover, R is the resistance of resistance 907.
[0090] By the formula 1 and the formula 2, the gate voltage VGS and the drain current ID at the time of allotting resistance 907, as shown in drawing 2 are searched for. At this time, it calculates with [to the variation in the threshold voltage Vth / of drain current ID] a rose.
[0091] For example, in a formula 1 and a formula 2, alpha is made into 2x10-6 F/V-s, and W/L is set to 1. Here, Vth takes the value of 2**0.1V and presupposes that it has 5% of variation.
[0092] First, R considers the case of 0 (when there is no resistance 907). V is set to 4V. A gate voltage VGS is set to 4V in accordance with V. The variation in the drain current at this time is about 10%. At this time, the average of drain current is abbreviation 8x10-6A.
[0093] Next, R considers the case of 1x106 ohms. V is set to 12V in order to maintain the average of drain current at abbreviation 8x10-6A. At this time, the variation in the drain current ID which receives with [of the threshold voltage Vth] a rose is suppressed to about 1%.
[0094] Shortly, R considers the case of 2x106 ohms. In order to maintain the average of drain current at abbreviation 8x10-6A, V is set to 20V. At this time, the variation in the drain current ID which receives with [of the threshold voltage Vth] a rose is suppressed to about 0.6%.
[0095] Thus, the variation in the drain current ID which receives with [of the threshold voltage Vth] a rose can be suppressed by allotting 907 for resistance and taking the large resistance.
[0096] It combines with an example 1 freely and this example can be carried out.
[0097] (Example 3) this example explains how to produce simultaneously TFT of the pixel section of the display which uses the drive method of this invention, and the drive circuit section (a source signal-line side drive circuit, gate signal line side drive circuit) prepared around it. However, in order to simplify explanation, suppose that the CMOS circuit which is a base unit is illustrated about the drive circuit section.
[0098] First, as shown in drawing 8 (A), the ground film 5002 which consists of insulator layers, such as a silicon-oxide film, a silicon nitride film, or an oxidization silicon nitride film, is formed on the substrate 5001 which consists of glass, such as barium borosilicate glass represented by #7059 glass of Corning, Inc., #1737 glass, etc., or alumino borosilicate glass. For example, 10-200 [nm] (preferably 50-100 [nm]) formation of SiH4, NH3, and the oxidization silicon-nitride-film 5002a produced from N2O is carried out by the plasma CVD method, and laminating formation of the oxidization nitriding hydrogenation silicon film 5002b similarly produced from SiH4 and N2O is carried out at the thickness of 50-200 [nm] (preferably 100-150 [nm]). Although this example showed the ground film 5002 as two-layer structure, you may form as structure which carried out the laminating the monolayer of the aforementioned insulator layer, or more than two-layer.
[0099] The island-like semiconductor layers 5003-5006 are formed by the crystalline-substance semiconductor film which produced the semiconductor film which has amorphous structure using the laser crystallizing method or the well-known heat crystallizing method. The thickness of these island-like semiconductor layers 5003-5006 is formed by the thickness of 25-80 [nm] (preferably 30-60 [nm]). Although there is no limitation in the material of a crystalline-substance semiconductor film, it is good to form with silicon or a silicon germanium (SiGe) alloy preferably.
[0100] In order to produce a crystalline-substance semiconductor film by the laser crystallizing method, a pulse oscillation type or a continuation luminescence type excimer laser, and an YAG laser and YVO4 laser are used. When using such laser, it is good to use the method of condensing to a line the laser beam emitted from the laser oscillation machine with optical system, and irradiating a semiconductor film. Although an operation person does **** selection, the conditions of crystallization are made into the pulse oscillation frequency 30 [Hz] when using an excimer laser, and set a laser energy density to 100-400 [mJ/cm2]

(typically 200-300 [mJ/cm2]). Moreover, it is good to consider as the pulse oscillation frequency 1-10 [kHz] using the 2nd higher harmonic, in using an YAG laser, and to set a laser energy density to 300-600 [mJ/cm2] (typically 350-500 [mJ/cm2]). and width of face 100-1000 [mum], for example, the laser beam which condensed to the line by 400 [mum], — the whole substrate surface — crossing — irradiating — the line at this time — the rate of superposition of a laser beam (rate of overlap) is performed as 80-98 [%]

[0101] Subsequently, the wrap gate insulator layer 5007 is formed for the island-like semiconductor layers 5003-5006. The gate insulator layer 5007 is formed using a plasma CVD method or a spatter by the insulator layer which sets thickness to 40-150 [nm], and contains silicon. At this example, it forms by the oxidization silicon nitride film by the thickness of 120 [nm]. Of course, a gate insulator layer is not limited to such an oxidization silicon nitride film, and may use the insulator layer containing other silicon as a monolayer or a laminated structure. For example, when using a silicon-oxide film, TEOS (Tetraethyl Orthosilicate) and O2 can be mixed by the plasma CVD method, and it can consider as reaction pressure 40 [Pa] and the substrate temperature 300-400 [**], it can be made to be able to discharge by the RF (13.56 [MHz]) and power flux density 0.5-0.8 [W/cm2], and can form. Thus, the silicon-oxide film produced can acquire a property good as a gate insulator layer by heat annealing of 400-500 [**] after that.

[0102] And the 1st electric conduction film 5008 for forming a gate electrode on the gate insulator layer 5007 and the 2nd electric conduction film 5009 are formed. In this example, the 1st electric conduction film 5008 is formed in the thickness of 50-100 [nm] by Ta, and the 2nd electric conduction film 5009 is formed in the thickness of 100-300 [nm] by W.

[0103] By the spatter, Ta film is formed by carrying out the spatter of the target of Ta by Ar. In this case, if Xe and Kr of optimum dose are added to Ar, the internal stress of Ta film can be eased and ablation of a film can be prevented. Moreover, although the resistivity of Ta film of alpha phase is 20 [muomegacm] grades and it can be used for a gate electrode, the resistivity of Ta film of beta phase is unsuitable for being 180 [muomegacm] grades and considering as a gate electrode. If the tantalum nitride with the crystal structure near alpha phase of Ta is formed in the ground of Ta by the thickness about 10-50 [nm] in order to form Ta film of alpha phase, Ta film of alpha phase can be obtained easily.

[0104] In forming W film, it forms W by the spatter used as the target. In addition, it can also form by the heat CVD using 6 tungsten fluoride (WF6). Anyway, in order to use it as a gate electrode, it is necessary to attain low resistance-ization, and as for the resistivity of W film, carrying out to below 20 [muomegacm] is desirable. In W, although W film can attain low resistivity-ization by enlarging crystal grain, when there are many impurity elements, such as oxygen, crystallization is checked and forms it into high resistance. From this, when based on a spatter, resistivity 9-20 [muomegacm] can be realized using W target of purity 99.9999 [%] by considering enough and forming W film so that there may be no mixing of the impurity out of a gaseous phase further at the time of membrane formation.

[0105] In addition, at this example, although Ta and the 2nd electric conduction film 5009 were set to W for the 1st electric conduction film 5008, it is not limited especially but the element chosen from any Ta, W, Ti, Mo, aluminum, and Cu etc. or the aforementioned element may be formed with the charge of an alloy or compound material made into a principal component. Moreover, you may use the semiconductor film represented by the polycrystal silicon film which doped impurity elements, such as Lynn. As a desirable thing, with an example of other combination other than this example Form the 1st electric conduction film 5008 by the tantalum nitride (TaN), and set the 2nd electric conduction film 5009 to W, and it is combined. The 1st electric conduction film 5008 is formed by the tantalum nitride (TaN), it combines, the 1st electric conduction film 5008 is formed by the tantalum nitride (TaN), and the combination for which the 2nd electric conduction film 5009 is set to aluminum and which sets the 2nd electric conduction film 5009 to Cu is mentioned.

[0106] Next, 1st etching processing for forming the mask 5010 by the resist and forming an electrode and wiring is performed. In this example, it carries out by mixing CF4 and Cl2 in the gas for etching, supplying RF (13.56 [MHz]) power of 500 [W] to a coil type electrode by the

pressure of 1 [Pa] using the ICP (Inductively Coupled Plasma:inductive-coupling type plasma) etching method, and generating plasma. RF (13.56 [MHz]) power of 100 [W] is supplied also to a substrate side (sample stage), and negative auto-bias voltage is impressed substantially. When CF4 and Cl2 are mixed, it **********s to the same extent in W film and Ta film.
[0107] On the above-mentioned etching conditions, the edge of the 1st conductive layer and the 2nd conductive layer serves as a taper configuration according to the effect of the bias voltage impressed to a substrate side by having been suitable in the configuration of the mask by the resist. The angle of the taper section becomes 15-45 degrees. In order to ********** without leaving a residue on a gate insulator layer, it is good to make etching time increase at a rate about 10-20 [%]. Since the selection ratios of the oxidization silicon nitride film to W film are 2-4 (typically 3), as for the field which the oxidization silicon nitride film exposed, over etching processing will ********** 20-50 [nm] grade. In this way, the conductive layers 5011-5016 (the 1st conductive layers 5011a-5016a and 2nd conductive layer 5011b-5016b) of the 1st configuration which consists of the 1st conductive layer and 2nd conductive layer by 1st etching processing are formed. At this time, the field where it **********ed 20-50 [nm] grade, and the field which is not covered by the conductive layers 5011-5016 of the 1st configuration became thin is formed in the gate insulator layer 5007. (Drawing 8 (B))
[0108] And the impurity element which performs 1st doping processing and gives n type is added. What is necessary is just to perform the method of doping with the ion doping method or ion-implantation. The conditions of the ion doping method set a dose to 1x1013 to 5x1014 [atoms/cm2], and perform acceleration voltage as 60-100 [keV]. the element which belongs to 15 groups as an impurity element which gives n type -- typical -- Lynn -- although (P) or arsenic (As) is used -- here -- Lynn -- (P) is used In this case, it becomes a mask to the impurity element with which conductive layers 5011-5015 give n type, and the 1st impurity range 5017-5025 is formed in a self-adjustment target. To the 1st impurity range 5017-5025, the impurity element which gives n type by the density range of 1x1020 to 1x1021 [atoms/cm3] is added. (Drawing 8 (B))
[0109] Next, as shown in drawing 8 (C), a resist mask performs 2nd etching processing, not removed. CF4, and Cl2 and O2 are used for etching gas, and W film is **********ed alternatively. At this time, the conductive layers 5026-5031 (the 1st conductive layers 5026a-5031a and 2nd conductive layer 5026b-5031b) of the 2nd configuration are formed by 2nd etching processing. At this time, the field where it **********ed to the pan 20-50 [nm] grade, and the field which is not covered by the conductive layers 5026-5031 of the 2nd configuration became thin is formed in the gate insulator layer 5007.
[0110] The etching reaction by the mixed gas of CF4 and Cl2 of W film or Ta film can be guessed from the vapor pressure of the radical or ion kind generated, and a resultant. If the vapor pressure of the fluoride and chloride of W and Ta is compared, WF6 which is the fluoride of W is extremely high, and WCl5, TaF5, and TaCl5 of others have it. [of the same grade] Therefore, in the mixed gas of CF4 and Cl2, it **********s in W film and Ta film. However, if O2 of optimum dose is added to this mixed gas, CF4 and O2 will react, it will be set to CO and F, and F radical or F ion will occur so much. Consequently, the etch rate of W film with the high vapor pressure of a fluoride increases. On the other hand, even if, as for Ta, F increases, there are few increases in an etch rate relatively. Moreover, since Ta tends to oxidize as compared with W, the front face of Ta oxidizes by adding O2. In order that the oxide of Ta may react neither with a fluorine nor chlorine, the etch rate of Ta film falls further. Therefore, it becomes possible to become possible to make a difference to the etch rate of W film and Ta film, and to make the etch rate of W film larger than Ta film.
[0111] And as shown in drawing 9 (A), 2nd doping processing is performed. In this case, the impurity element which lowers a dose and gives n type as conditions for high acceleration voltage rather than the 1st doping processing is doped. For example, a new impurity range is formed inside the 1st impurity range which set acceleration voltage to 70-120 [keV], carried out by the dose of 1x1013 [atoms/cm2], and was formed in the island-like semiconductor layer by drawing 8 (B). Doping uses the conductive layers 5026-5030 of the 2nd configuration as a mask to an impurity element, and it dopes them so that an impurity element may be

added by the field of the 1st conductive-layera [5026]-5030a bottom. In this way, the 3rd impurity range 5032-5036 is formed. The concentration of Lynn (P) added by this 3rd impurity range 5032-5036 has the loose concentration gradient according to the thickness of the taper section of the 1st conductive layer 5026a-5030a. In addition, in the semiconductor layer which laps with the taper section of the 1st conductive layer 5026a-5030a, although high impurity concentration is low a little toward the edge of the taper section of the 1st conductive layer 5026a-5030a to the inside, it is concentration almost of the same grade.
[0112] As shown in drawing 9 (B), 3rd etching processing is performed. CHF6 is used for etching gas and it carries out using a reactive-ion-etching method (the RIE method). The field where the taper section of the 1st conductive layer 5026a-5031a is **********ed partially, and the 1st conductive layer laps with a semiconductor layer by 3rd etching processing is reduced. By 3rd etching processing, the conductive layers 5037-5042 (the 1st conductive layers 5037a-5042a and 2nd conductive layer 5037b-5042b) of the 3rd configuration are formed. At this time, the field where it **********ed to the pan 20-50 [nm] grade, and the field which is not covered by the conductive layers 5037-5042 of the 3rd configuration became thin is formed in the gate insulator layer 5007.
[0113] The 2nd impurity range 5032b-5036b between the 3rd impurity range 5032a-5036a which laps with the 1st conductive layer 5037a-5041a in the 3rd impurity range 5032-5036 by 3rd etching processing, and the 1st impurity range and the 3rd impurity range is formed.
[0114] And as shown in drawing 9 (C), the 4th impurity range 5043-5054 of a conductivity type contrary to the 1st conductivity type is formed in the island-like semiconductor layers 5004 and 5006 which form p-channel type TFT. The conductive layers 5038b and 5041b of the 3rd configuration are used as a mask to an impurity element, and an impurity range is formed in a self-adjustment target. At this time, the island-like semiconductor layers 5003 and 5005 and the wiring section 5042 which form n channel type TFT cover the whole surface with the resist mask 5200. Although Lynn is added by impurity ranges 5043-5054 by concentration different, respectively, it forms by the ion doping method using the diboron hexahydride (B-2 H6), and is made for high impurity concentration to be set to 2x1020 to 2x1021 [atoms/cm3] also in which the field.
[0115] An impurity range is formed in each island-like semiconductor layer at the process to the above. The conductive layers 5037-5041 of the 3rd configuration which lap with an island-like semiconductor layer function as a gate electrode. Moreover, 5042 functions as an island-like source signal line.
[0116] After removing the resist mask 5200, the process which activates the impurity element added by each island-like semiconductor layer for the purpose of control of a conductivity type is performed. This process is performed by the heat annealing method for using a furnace annealing furnace. In addition, the laser annealing method or the rapid thermal annealing method (the RTA method) is applicable. By the heat annealing method, preferably, in the nitrogen-gas-atmosphere mind below 0.1 [ppm], it carries out by 500-600 [**] typically, and an oxygen density performs [400-700 [**] and] heat treatment of 4 hours this example below 1 [ppm] 500 [**]. However, it is desirable to be activated after forming a layer insulation film (let silicon be a principal component) in order to protect wiring etc., when the wiring material used for the conductive layers 5037-5042 of the 3rd configuration is weak with heat.
[0117] Furthermore, in the atmosphere containing the hydrogen of 3-100 [%], heat treatment of 1 - 12 hours is performed by 300-450 [**], and the process which hydrogenates an island-like semiconductor layer is performed. This process is a process which carries out termination of the dangling bond of a semiconductor layer by the hydrogen excited thermally. As other meanses of hydrogenation, you may perform plasma hydrogenation (the hydrogen excited by plasma is used).
[0118] Subsequently, as shown in drawing 10 (A), the 1st layer insulation film 5055 is formed by the thickness of 100-200 [nm] from an oxidization silicon nitride film. the 1st [after forming the 2nd layer insulation film 5056 which consists of an organic insulator material on it] layer insulation film 5055, the 2nd layer insulation film 5056, and the gate insulator layer

5007 -- receiving -- a contact hole -- forming -- each wiring (connection wiring and signal line are included) 5057- after carrying out patterning formation of 5062 and 5064, patterning formation of the pixel electrode 5063 which meets with the connection wiring 5062 is carried out

[0119] As 2nd layer insulation film 5056, a polyimide, a polyamide, an acrylic, BCB (benz-cyclo-butene), etc. can be used as the organic resin using a film made from an organic resin. Since especially the 2nd layer insulation film 5056 has the strong implications of flattening, its acrylic excellent in flat nature is desirable. At this example, an acrylic film is formed by the thickness which can fully carry out flattening of the level difference formed of TFT. desirable -- 1-5 [mum] (still more preferably 2-4 [mum]) -- then, it is good

[0120] Formation of a contact hole forms the contact hole which reaches the n type impurity ranges 5017, 5018, 5021, and 5023 and the p type impurity ranges 5043-5054, the contact hole which reaches wiring 5042, the contact hole (not shown) which reaches a current supply line, and the contact hole (not shown) which reaches a gate electrode using dry etching or wet etching, respectively.

[0121] moreover, wiring (connection wiring and signal line are included) 5057- what carried out patterning of the cascade screen of the three-tiered structure which carried out the aluminum film which contains 100 [nm] and Ti for Ti film by 300 [nm] as 5062 and 5064, and carried out continuation formation of the Ti film 150 [nm] by the spatter to the desired configuration is used Of course, you may use other electric conduction films.

[0122] Moreover, in this example, the ITO film was formed in the thickness of 110 [nm] as a pixel electrode 5063, and patterning was performed. Contact is taken by arranging the pixel electrode 5063 so that it may lap in contact with the connection wiring 5062. Moreover, you may use for indium oxide the transparent electric conduction film which mixed the zinc oxide (ZnO) of 2-20 [%]. This pixel electrode 5063 turns into an anode plate of an EL element. (Drawing 10 (A))

[0123] Next, as shown in drawing 10 (B), the insulator layer (this example oxidization silicon film) containing silicon is formed in the thickness of 500 [nm], opening is formed in the position corresponding to the pixel electrode 5063, and the 3rd layer insulation film 5065 which functions as a bank is formed. In case opening is formed, it can consider as the side attachment wall of a taper configuration easily by using the wet etching method. Since degradation of EL layer resulting from a level difference will pose a remarkable problem if the side attachment wall of opening is not fully gently-sloping, cautions are required.

[0124] Next, continuation formation of the EL layer 5066 and the cathode (MgAg electrode) 5067 is carried out without carrying out air release using a vacuum deposition method. In addition, the thickness of the EL layer 5066 should just set thickness of 80-200 [nm] (typically 100-120 [nm]), and cathode 5067 to 180-300 [nm] (typically 200-250 [nm]).

[0125] At this process, EL layer and cathode are formed one by one to the pixel corresponding to red, the pixel which corresponds green, and the pixel which corresponds blue. however, the ** which does not use photolithography technology since EL layer is lacking in the resistance over a solution -- each color -- you have to form individually Then, it is desirable that hide except a desired pixel using a metal mask, and only a required part forms EL layer and cathode alternatively.

[0126] That is, the mask which hides except [all] the pixel corresponding to red first is set, and EL layer of red luminescence is alternatively formed using the mask. Subsequently, the mask which hides except [all] the pixel which corresponds green is set, and EL layer of green luminescence is alternatively formed using the mask. Subsequently, the mask which hides except [all] the pixel which corresponds blue similarly is set, and EL layer of blue luminescence is alternatively formed using the mask. In addition, although it has indicated that a mask which is altogether different here is used, you may use the same mask about.

[0127] Although the method which forms three kinds of EL elements corresponding to RGB was used here, you may use the method which combined the method which combined the EL element and light filter of white luminescence, blue, or the EL element and fluorescent substance (color conversion layer of fluorescence nature : CCM) of bluish green

luminescence, the method which puts the EL element corresponding to RGB on cathode (counterelectrode) using a transparent electrode.

[0128] In addition, a material well-known as an EL layer 5066 can be used. As a well-known material, when driver voltage is taken into consideration, it is desirable to use an organic material. For example, what is necessary is just to let four layer structures which become in a hole-injection layer, an electron hole transporting bed, a luminous layer, and an electron-injection layer be EL layers.

[0129] Next, on the pixel (pixel of the same line) which has TFT for switching by which the gate electrode was connected to the same gate signal line, a metal mask is used and cathode 5067 is formed. In addition, although MgAg was used as cathode 5067 in this example, this invention is not limited to this. You may use other well-known material as cathode 5067.

[0130] The passivation film 5068 which becomes the last by the silicon nitride film is formed in the thickness of 300 [nm]. By forming the passivation film 5068, the EL layer 5066 can be protected from moisture etc. and the reliability of an EL element can be raised further.

[0131] In this way, EL display of structure as shown in drawing 10 (B) is completed. In addition, in the production process of EL display in this example, on the composition of a circuit, and the relation of a process, although the gate signal line is formed by aluminum which is the wiring material which forms a source signal line and forms the drain source electrode by Ta and W which are the material which forms the gate electrode, you may use a different material.

[0132] By the way, by arranging TFT of the optimal structure not only for the pixel section but the drive circuit section, EL display of this example shows very high reliability, and its operating characteristic may also improve. Moreover, it is also possible to add metal catalysts, such as nickel, in a crystallization process, and to raise crystallinity. It is possible to carry out drive frequency of a source signal-line drive circuit by it more than 10 [MHz].

[0133] First, TFT which has the structure of reducing hot carrier pouring so that a working speed may not be reduced as much as possible is used as n channel type TFT of the CMOS circuit which forms the drive circuit section. In addition, as a drive circuit here, the transmission gate in a shift register, a buffer, a level shifter, the latch in a line sequential drive, and a point sequential drive etc. is contained.

[0134] In the case of this example, the barrier layer of n channel type TFT includes a source field, a drain field, the overlap LDD field (LOV field) that laps with a gate electrode on both sides of a gate insulator layer in between, the offset LDD field (LOFF field) which does not lap with a gate electrode on both sides of a gate insulator layer in between, and a channel formation field.

[0135] Moreover, since degradation by hot carrier pouring hardly worries p-channel type TFT of a CMOS circuit, it does not need to prepare especially a LDD field. Of course, it is also possible to prepare a LDD field like n channel type TFT, and to take the cure against a hot carrier.

[0136] In addition, in a drive circuit, when a CMOS circuit to which current flows a channel formation field bidirectionally, i.e., a CMOS circuit which the role of a source field and a drain field replaces, is used, as for n channel type TFT which forms a CMOS circuit, it is desirable to form a LDD field in the form which inserts a channel formation field into both the sides of a channel formation field. As such an example, the transmission gate used for a point sequential drive is mentioned. Moreover, in a drive circuit, when a CMOS circuit with the need of stopping the OFF state current low as much as possible is used, as for n channel type TFT which forms a CMOS circuit, it is desirable to have the LOV field. As such an example, the transmission gate used for a point sequential drive is mentioned too.

[0137] In addition, when completing to the state of drawing 10 (B) in fact, airtightness is high and it is desirable to carry out packaging (enclosure) by the sealing material of the few protection films (a laminate film, ultraviolet-rays hardening resin film, etc.) of degasifying or a translucency so that the open air may not ** further. In that case, if the interior of a sealing material is made into an inert atmosphere or a hygroscopic material (for example, barium oxide) is arranged inside, the reliability of an EL element will improve.

[0138] Moreover, if processing of packaging etc. raises airtightness, the connector (flexible print circuit : FPC) for connecting the terminal and external signal terminal which were taken about from the element formed on the substrate or the circuit will be attached, and it will complete as a product. The state where it changed into such a state where it can ship is called display in this specification.
[0139] Moreover, if the process shown by this example is followed, the number of photo masks required for production of display can be stopped. Consequently, a process can be shortened and it can contribute to reduction of a manufacturing cost, and improvement in the yield.
[0140] (Example 4) Drawing 11 (A) is a plan of EL display which uses the drive method of this invention. In drawing 11 (A), for 4010, as for the pixel section and 4012, a substrate and 4011 are [a source signal-line drive circuit and 4013] gate signal side drive circuits, and each drive circuit results in FPC4017 through wiring 4014 and 4016, and is connected to an external instrument.
[0141] this time — at least — the pixel section — as a drive circuit and the pixel section are surrounded preferably, the covering material 6000, the sealing material (it is also called housing material) 7000, and the sealant (the 2nd sealing material) 7001 are formed
[0142] Moreover, drawing 11 (B) is the cross-section structure of EL display of this example, and TFT4022 for drive circuits (however, the CMOS circuit which combined n channel type TFT and p-channel type TFT here is illustrated.), and TFT4023 (however, only the TFT for EL drive is illustrated here.) for the pixel sections are formed on the substrate 4010 and the ground film 4021. Such TFT should just use well-known structures (top gate structure or bottom gate structure).
[0143] If TFT4022 for drive circuits and TFT4023 for the pixel sections are completed, the pixel electrode 4027 which becomes by the transparent electric conduction film electrically connected with the drain of TFT4023 for the pixel sections will be formed on the layer insulation film (flattening film) 4026 which becomes with resin material. As a transparent electric conduction film, the compound (referred to as ITO) of indium oxide and the tin oxide or the compound of indium oxide and a zinc oxide can be used. And if the pixel electrode 4027 is formed, an insulator layer 4028 will be formed and opening will be formed on the pixel electrode 4027.
[0144] Next, the EL layer 4029 is formed. What is necessary is just to make the EL layer 4029 into a laminated structure or monolayer structure, combining freely well-known EL material (a hole-injection layer, an electron hole transporting bed, a luminous layer, an electronic transporting bed, and electron-injection layer). As what structure it considers should just use well-known technology. Moreover, there are low-molecular system material and macromolecule system (polymer system) material as EL material. Although a vacuum deposition is used when using low-molecular system material, when using macromolecule system material, it is possible to use simple methods, such as the spin coat method, print processes, or the ink-jet method.
[0145] In this example, EL layer is formed by the vacuum deposition using a shadow mask. By forming the luminous layer (a red luminous layer, a green luminous layer, and blue luminous layer) in which luminescence from which wavelength differs for every pixel using a shadow mask is possible, color display becomes possible. In addition, although there are a method which combined the color conversion layer (CCM) and the light filter, and a method which combined the white luminous layer and the light filter, you may use which method. Of course, it can also consider as EL display of monochrome luminescence.
[0146] If the EL layer 4029 is formed, cathode 4030 will be formed on it. As for the moisture which exists in the interface of cathode 4030 and the EL layer 4029, or oxygen, eliminating as much as possible is desirable. Therefore, the device of forming cathode 4030 without carrying out continuation membrane formation of the EL layer 4029 and the cathode 4030 in a vacuum, or forming the EL layer 4029 by the inert atmosphere and carrying out air release is required. At this example, the above membrane formation is enabled by using the membrane formation equipment of a multi chamber method (cluster tool method).
[0147] In addition, in this example, the laminated structure of a LiF (lithium fluoride) film and

aluminum (aluminum) film is used as cathode 4030. The LiF (lithium fluoride) film of 1nm ** is specifically formed by the vacuum deposition on the EL layer 4029, and the aluminum film of 300nm ** is formed on it. Of course, you may use the MgAg electrode which is a well-known cathode material. And cathode 4030 is connected to wiring 4016 in the field shown by 4031. Wiring 4016 is a current supply line for giving predetermined voltage to cathode 4030, and is connected to FPC4017 through the conductive paste material 4032.

[0148] In order to connect cathode 4030 and wiring 4016 electrically in the field shown in 4031, it is necessary to form a contact hole in the layer insulation film 4026 and an insulator layer 4028. What is necessary is just to form these at the time of etching of the layer insulation film 4026, and etching of an insulator layer 4028 (at the time of formation of the contact hole for pixel electrodes) (at the time of formation of opening in front of EL stratification). Moreover, in case an insulator layer 4028 is **********ed, even the layer insulation film 4026 may ********** by package. In this case, if the layer insulation film 4026 and an insulator layer 4028 are the same resin material, let the configuration of a contact hole be a good thing.

[0149] Thus, the front face of the formed EL element is worn and the passivation film 6003, a filler 6004, and the covering material 6000 are formed.

[0150] Furthermore, as the EL-element section is surrounded, a sealing material 7000 is formed between the covering material 6000 and a substrate 4010, and a sealant (the 2nd sealing material) 7001 is further formed in the outside of a sealing material 7000.

[0151] At this time, this filler 6004 functions also as adhesives for pasting up the covering material 6000. As a filler 6004, PVC (polyvinyl chloride), an epoxy resin, silicone resin, and PVB (polyvinyl butyral) or EVA (ethylene vinyl acetate) can be used. If the drying agent is prepared in the interior of this filler 6004, since the moisture absorption effect can be held, it is desirable.

[0152] Moreover, you may make a spacer contain in a filler 6004. At this time, a spacer may be made into the particulate matter which consists of BaO etc., and hygroscopicity may be given to the spacer itself.

[0153] When a spacer is formed, the passivation film 6003 can ease spacer **. Moreover, you may prepare the resin film which eases spacer ** independently [the passivation film 6003].

[0154] Moreover, as covering material 6000, a glass plate, an aluminum plate, a stainless steel board, an FRP (Fiberglass-Reinforced Plastics) board, a PVF (polyvinyl fluoride) film, a Mylar film, polyester film, or an acrylic film can be used. In addition, when using PVB and EVA as a filler 6004, it is desirable to use the sheet of the structure which sandwiched the dozens of micrometers aluminium wheel with the PVF film or the Mylar film.

[0155] However, depending on the luminescence direction (the direction of a light emission) from an EL element, the covering material 6000 needs to have a translucency.

[0156] Moreover, wiring 4016 is electrically connected to FPC4017 through the crevice between a sealing material 7000 and a sealant 7001, and a substrate 4010. In addition, although wiring 4016 was explained here, other wiring 4014 is similarly connected to FPC4017 electrically through the bottom of a sealing material 7000 and a sealant 7001.

[0157] In addition, although the sealing material 7000 is attached in drawing 11 so that the covering material 6000 may be pasted up and the side (disclosure side) of a filler 6004 may be worn after forming a filler 6004, after attaching the covering material 6000 and a sealing material 7000, you may form a filler 6004. In this case, the inlet of the filler which leads to the opening currently formed by the substrate 4010, the covering material 6000, and the sealing material 7000 is prepared. And the aforementioned opening is made into a vacua (10 to 2 or less Torrs), and after dipping an inlet in the tank containing the filler, atmospheric pressure besides an opening is made higher than the atmospheric pressure in an opening, and it is filled up with a filler into an opening.

[0158] (Example 5) Next, the example which produced EL display of a different gestalt from drawing 11 (A) and (B) is explained using drawing 12 (A) and (B). Since the thing of the same number as drawing 11 (A) and (B) has pointed out the same portion, explanation is omitted.

[0159] Drawing 12 (A) is the plan of EL display of this example, and shows the cross section

which cut drawing 12 (A) by A-A' to drawing 12 (B).
[0160] According to drawing 11 , the front face of an EL element is worn and even the passivation film 6003 is formed.
[0161] Furthermore, a filler 6004 is formed as an EL element is covered. This filler 6004 functions also as adhesives for pasting up the covering material 6000. As a filler 6004, PVC (polyvinyl chloride), an epoxy resin, silicone resin, and PVB (polyvinyl butyral) or EVA (ethylene vinyl acetate) can be used. If the drying agent is prepared in the interior of this filler 6004, since the moisture absorption effect can be held, it is desirable.
[0162] Moreover, you may make a spacer contain in a filler 6004. At this time, a spacer may be made into the particulate matter which consists of BaO etc., and hygroscopicity may be given to the spacer itself.
[0163] When a spacer is formed, the passivation film 6003 can ease spacer **. Moreover, apart from a passivation film, you may prepare the resin film which eases spacer **.
[0164] Moreover, as covering material 6000, a glass plate, an aluminum plate, a stainless steel board, an FRP (Fiberglass-Reinforced Plastics) board, a PVF (polyvinyl fluoride) film, a Mylar film, polyester film, or an acrylic film can be used. In addition, when using PVB and EVA as a filler 6004, it is desirable to use the sheet of the structure which sandwiched the dozens of micrometers aluminium wheel with the PVF film or the Mylar film.
[0165] However, depending on the luminescence direction (the direction of a light emission) from an EL element, the covering material 6000 needs to have a translucency.
[0166] Next, after pasting up the covering material 6000 using a filler 6004, a frame material 6001 is attached so that the side (disclosure side) of a filler 6004 may be worn. A frame material 6001 is pasted up by the sealing material (it functions as adhesives) 6002. Although it is desirable at this time to use a photoresist as a sealing material 6002, you may use thermosetting resin, as long as the thermal resistance of EL layer allows. In addition, as for a sealing material 6002, it is desirable that it is the material which penetrates neither moisture nor oxygen as much as possible. Moreover, the drying agent may be added inside the sealing material 6002.
[0167] Moreover, wiring 4016 is electrically connected to FPC4017 through the crevice between a sealing material 6002 and a substrate 4010. In addition, although wiring 4016 was explained here, other wiring 4014 is similarly connected to FPC4017 electrically through the bottom of a sealing material 6002.
[0168] In addition, although the frame material 6001 is attached in drawing 12 so that the covering material 6000 may be pasted up and the side (disclosure side) of a filler 6004 may be worn after forming a filler 6004, after attaching the covering material 6000 and a frame material 6001, you may form a filler 6004. In this case, the inlet of the filler which leads to the opening currently formed by the substrate 4010, the covering material 6000, and the frame material 6001 is prepared. And the aforementioned opening is made into a vacua (10 to 2 or less Torrs), and after dipping an inlet in the tank containing the filler, atmospheric pressure besides an opening is made higher than the atmospheric pressure in an opening, and it is filled up with a filler into an opening.
[0169] (Example 6) The still more detailed cross-section structure of the pixel section in EL display is shown in drawing 13 . In drawing 13 , TFT4502 for switching prepared on the substrate 4501 uses n channel type TFT formed using the well-known method. In this example, it is considering as the double-gate structure of having two gate electrodes 39a and 39b. It becomes the structure where the serial of the two TFT was substantially carried out by considering as double-gate structure, and there is an advantage that an OFF state current value can be reduced. In addition, although considered as double-gate structure in this example, single-gate structure is sufficient and multi-gate structure with triple gate structure or the gate number beyond it is sufficient. Moreover, you may use p-channel type TFT formed using the well-known method.
[0170] Moreover, TFT4503 for EL drive uses n channel type TFT formed using the well-known method. By wiring 36, the gate electrode 37 of TFT for EL drive is electrically connected to the drain wiring 35 of TFT4502 for switching.

[0171] Since TFT for EL drive is an element for controlling the amount of current which flows an EL element, much current flows and the danger of degradation by heat or degradation by the hot carrier is also a high element. Therefore, the structure of this invention of preparing a LDD field so that it may lap with the drain side of TFT4503 for EL drive through a gate insulator layer at a gate electrode is very effective.
[0172] Moreover, although the single-gate structure of having one gate electrode 37 is illustrating TFT4503 for EL drive in this example, it is good also as multi-gate structure where two or more TFT was connected in series. Furthermore, it is good also as structure which connects two or more TFT in parallel, divides a channel formation field into plurality substantially, and enabled it to emit heat at high efficiency. Such structure is effective as a cure against degradation by heat.
[0173] Moreover, in this example, although top gate type TFT is used, you may use bottom gate type TFT.
[0174] Moreover, the source wiring 40 is connected to a current supply line (not shown), and fixed voltage is always applied.
[0175] The 1st passivation film 41 is formed on TFT4502 for switching, and TFT4503 for EL drive, and the flattening film 42 which becomes by the resin insulator layer is formed on it. It is very important to carry out flattening of the level difference by TFT using the flattening film 42. Since EL layer formed behind is very thin, poor luminescence may be caused when a level difference exists. Therefore, before forming a pixel electrode so that EL layer can be formed as much as possible in a flat side, it is desirable to carry out flattening.
[0176] Moreover, 43 is a pixel electrode (cathode of an EL element in this case) which becomes by the high electric conduction film of reflection nature, and is electrically connected to the drain wiring 33 of TFT4503 for EL drive. as the pixel electrode 43 — an aluminium alloy film, a copper alloy film, or a silver-alloy film — low — it is desirable to use electric conduction [****] films or those cascade screens Of course, it is good also as a laminated structure with other electric conduction films.
[0177] Moreover, a luminous layer 45 is formed into the slot (it is equivalent to a pixel) formed of the banks 44a and 44b formed by the insulator layer (preferably resin). In addition, although only 1 pixel is illustrated here, you may make and divide the luminous layer corresponding to each color of R (red), G (green), and B (blue). pi conjugate polymer system material is used as an organic EL material made into a luminous layer. As a typical polymer system material, a poly para-phenylene vinylene (PPV) system, a polyvinyl-carbazole (PVK) system, the poly fluorene system, etc. are mentioned.
[0178] In addition, what is necessary is just to use material which was indicated by "H.Shenk, H.Becker, O.Gelsen, E.Kluge, W.Kreuder, and H.Spreitzer, "Polymers forLight Emitting Diodes", Euro Display, Proceedings, 1999, p.33-37", and JP,10-92576,A, for example, although there is a thing of various molds as a PPV system organic EL material.
[0179] What is necessary is to use a polyphenylene vinylene for a cyano polyphenylene vinylene and the luminous layer which emits light green, and just to use a polyphenylene vinylene or the poly alkyl phenylene for the luminous layer which emits light blue at the luminous layer which emits light in red as a concrete luminous layer. thickness — 30-150nm (preferably 40-100nm) -- then, it is good
[0180] However, the above example is an example of organic EL material which can be used as a luminous layer, and there is no need of limiting to this. What is necessary is just to form EL layer (layer for moving luminescence and the carrier for it), combining freely a luminous layer, a charge transporting bed, or a charge pouring layer.
[0181] For example, although this example showed the example which uses polymer system material as a luminous layer, you may use low-molecular system organic EL material. Moreover, it is also possible to use inorganic material, such as a silicon carbide, as a charge transporting bed or a charge pouring layer. Such organic EL material and inorganic material can use a well-known material.
[0182] In this example, it is considering as EL layer of the laminated structure which formed the hole-injection layer 46 which becomes by PEDOT (poly thiophene) or PAni (poly aniline)

on the luminous layer 45. And on the hole-injection layer 46, the anode plate 47 which becomes by the transparent electric conduction film is formed. Since light generated by the luminous layer 45 is emitted toward an upper surface side in the case of this example (going in the direction where the substrate 4501 in which TFT was formed is opposite), an anode plate must be a translucency. Although the compound of indium oxide and the tin oxide and the compound of indium oxide and a zinc oxide can be used as a transparent electric conduction film, after forming a heat-resistant low luminous layer and a heat-resistant hole-injection layer, in order to form, what can form membranes at low temperature as much as possible is desirable.

[0183] When formed to an anode plate 47, EL element 4505 is completed. In addition, EL element 4505 here is formed by the pixel electrode (cathode) 43, the luminous layer 45, the hole-injection layer 46, and the anode plate 47. Since the area of a pixel is made to carry out simultaneously coincidence of the pixel electrode 43, the whole pixel functions as an EL element. Therefore, the use efficiency of luminescence is very high and the bright image display of it becomes possible.

[0184] Moreover, in this example, the 2nd passivation film 48 is further formed on the anode plate 47. As the 2nd passivation film 48, a silicon nitride film or a nitriding oxidization silicon film is desirable. This purpose is intercepting the exterior and an EL element, and has both the meaning which prevents degradation by oxidization of organic EL material, and the meaning which suppresses degasifying from organic EL material. Thereby, the reliability of EL display is raised.

[0185] As mentioned above, EL display using the drive method of this invention has the pixel section which consists of a pixel of structure like drawing 13 , and fully has TFT for low switching and TFT for EL drive strong against hot carrier pouring of an OFF state current value. Therefore, it has high reliability and EL display in which good image display is possible is obtained.

[0186] (Example 7) this example explains the structure where the structure of EL element 4505 was reversed, in the pixel section shown in the example 6. Drawing 14 is used for explanation. In addition, since different points from the structure of drawing 13 are only the portion of an EL element, and TFT for EL drive, other explanation is given to omit.

[0187] In drawing 14 , TFT4503 for EL drive uses p-channel type TFT formed using the well-known method.

[0188] In this example, a transparent electric conduction film is used as a pixel electrode (anode plate) 50. The electric conduction film which specifically becomes with the compound of indium oxide and a zinc oxide is used. Of course, you may use the electric conduction film which becomes with the compound of indium oxide and the tin oxide.

[0189] And after the banks 51a and 51b which become by the insulator layer are formed, the luminous layer 52 which becomes by the polyvinyl carbazole by solution application is formed. The electron-injection layer 53 which becomes by potassium acetylacetonate (written as acacK) on it, and the cathode 54 which becomes by the aluminium alloy are formed. In this case, cathode 54 functions also as a passivation film. In this way, EL element 4701 is formed.

[0190] In the case of this example, the light generated in the luminous layer 52 is emitted toward the direction of the substrate 4501 in which TFT was formed as shown by the arrow.

[0191] (Example 8) this example explains the composition of a source signal-line drive circuit.

[0192] The circuit diagram of a source signal-line drive circuit is shown in drawing 6 . It is arranged as shift register 8801, latch (A), (8802), and latch (B) and (8803) ** shows in drawing. In this example, 1 set of latches (A), (8802), 1 set of latches (B), and (8803) correspond to four source signal-line S_a-S_d. Moreover, although the level shifter which changes the width of face of the amplitude of the voltage which a signal has was not prepared in this example, you may make a designer prepare suitably.

[0193] Clock signal CLKB, the start pulse signal SP, and driving-direction change signal SL/R which the polarity of clock signals CLK and CLK reversed are inputted into a shift register 8801 from the wiring shown in drawing, respectively. Moreover, the digital signal VD inputted from the outside is quadrisected, and is inputted into a latch (A) and (8802) from the wiring

shown in drawing. Signal S_LATb which the polarity of latch signal S_Local Area Transport and S_Local Area Transport reversed is inputted into a latch (B) and (8803) from the wiring shown in drawing, respectively.
[0194] If the signal from a shift register 8801 is inputted, a latch (A) and (8802) will acquire four signals simultaneously from the quadrisected digital signal VD. By latch signal S_Local Area Transport and S_LATb, a latch (B) and (8803) hold a digital signal VD, and it outputs to source signal-line S_a-S_d.
[0195] Although this example described the technique of sampling simultaneously the signal corresponding to a four source signal line using the quadrisected video signal, generally you may sample simultaneously the signal corresponding to a n source signal line using the digital signal of which n division was done.
[0196] The detailed composition of a latch (A) and (8802) is explained taking the case of a part of latch (A) corresponding to source signal-line S_a, and (8802). [8804] A part of latch (A) and (8802) have two clocked inverters and two inverters. [8804]
[0197] Some [8804] plans of a latch (A) and (8802) are shown in drawing 7 . 831a and 831b are the barrier layers of TFT which forms one of the inverters which a part of latch (A) and (8802) have, respectively, and 836 is the common gate electrode of TFT which forms one of the inverters of these. [8804] Moreover, 832a and 832b are the barrier layers of TFT which forms another inverter which a part of latch (A) and (8802) have, respectively, and 837a and 837b are the gate electrodes prepared on barrier-layer 832a and 832b, respectively. [8804] In addition, the gate electrodes 837a and 837b are connected electrically.
[0198] 833a and 833b are the barrier layers of TFT which forms one of the clocked inverters which a part of latch (A) and (8802) have, respectively. [8804] On barrier-layer 833a, the gate electrodes 838a and 838b are formed, and it has double-gate structure. Moreover, the gate electrodes 838b and 839 are formed on barrier-layer 833b, and it has double-gate structure.
[0199] 834a and 834b are the barrier layers of TFT which forms another clocked inverter which a part of latch (A) and (8802) have, respectively. [8804] The gate electrodes 839 and 840 are formed on barrier-layer 834a, and it has double-gate structure. Moreover, the gate electrodes 840 and 841 are formed on barrier-layer 834b, and it has double-gate structure.
[0200] (Example 9) this example explains the example which produced EL display which uses the drive method of this invention using drawing 15 (A) and (B). Drawing 15 (A) is the plan showing the state where it carried out to enclosure of an EL element in the active-matrix substrate in which the EL element was formed. As for a source signal-line drive circuit and 6802, 6801 shown by the dotted line is [a gate signal line drive circuit and 6803] the pixel sections. Moreover, between the inside covering material and active-matrix substrates by which the 1st sealant and 6806 are the 2nd sealant and were surrounded by the 1st sealant 6805, as for 6804, a filler 6807 (refer to drawing 15 (B)) is formed, as for covering material and 6805.
[0201] In addition, 6808 is connection wiring for transmitting the signal inputted into the source signal-line drive circuit 6801, the gate signal line drive circuit 6802, and the pixel section 6803, and receives a video signal and a clock signal from FPC (flexible print circuit) 6809 which serves as an end-connection child with an external instrument.
[0202] Here, the cross section equivalent to the cross section which cut drawing 15 (A) by A-A' is shown in drawing 15 (B). In addition, the same sign is used for the same part in drawing 15 (A) and (B).
[0203] As shown in drawing 15 (B), on the substrate 6800, the pixel section 6803 and the source side drive circuit 6801 are formed, and the pixel section 6803 is formed in TFT6851 (henceforth TFT for EL drive) and its drain field for controlling the current which flows to an EL element of two or more pixels containing the pixel electrode 6852 grade connected electrically. TFT6851 for EL drive is set to p-channel type TFT in this example. Moreover, the source signal-line drive circuit 6801 is formed using the CMOS circuit which combined n channel type TFT6853 and p-channel type TFT6854 complementary.
[0204] each -- a pixel -- a pixel -- an electrode -- the bottom -- a light filter -- (-- R --) -- 6855 -- a light filter -- (-- G --) -- 6856 -- and -- a light filter -- (-- B --) -- (-- not

illustrating --) -- having -- **** . A light filter (R) is a light filter which extracts red light, and the light filter from which a light filter (G) extracts green light, and a light filter (B) are light filters which extract a blue glow here. In addition, a light filter (G) 6856 is formed in the pixel of green luminescence, and a light filter (R) 6855 is formed for a light filter (B) in the pixel of red luminescence at the pixel of blue luminescence.

[0205] As an effect at the time of preparing these light filters, the point that the color purity of the luminescent color improves first is mentioned. for example, red light emanates from the EL element from the pixel of red luminescence — having (it emanating toward a pixel electrode side in this example) — red purity can be raised by letting this red light pass to the light filter which extracts red light In the case of other green light and a blue glow, this is the same.

[0206] Moreover, with the structure where the conventional light filter is not used, the light which invaded from the outside of EL display excites the luminous layer of an EL element, and the problem from which desired coloring is not obtained may arise. However, only the light of specific wavelength ceases to go into an EL element by preparing a light filter like this example. That is, it is possible to prevent fault an EL element will be excited by the light from the outside.

[0207] In addition, although the conventional proposal of the structure of preparing a light filter was made, the EL element used the thing of white luminescence. In this case, since the light of other wavelength was cut for extracting red light, the fall of brightness had been caused. It seems that however, the fall of brightness is not caused in this example in order to let the red light emitted, for example from the EL element pass to the light filter which extracts red light.

[0208] Next, the pixel electrode 6852 is formed by the transparent electric conduction film, and functions as an anode plate of an EL element. Moreover, an insulator layer 6857 is formed in the ends of the pixel electrode 6852, and the luminous layer 6858 which emits light in red further, and the luminous layer 6859 which emits light green are formed. In addition, although not illustrated, the luminous layer which emits light blue is prepared in the adjoining pixel, and color display is performed to it by the pixel corresponding to red, green, and blue. Of course, the light filter from which the pixel in which the blue luminous layer was prepared extracts blue is prepared.

[0209] In addition, not only an organic material but inorganic material can be used as an EL material. Moreover, it is good also as a laminated structure which combined not only a luminous layer but an electron-injection layer, an electronic transporting bed, an electron hole transporting bed, and a hole-injection layer.

[0210] Moreover, on each luminous layer, the cathode 6860 of an EL element is had and formed by the electric conduction film which has shading nature. This cathode 6860 is common to all pixels, and is electrically connected to FPC6809 via the connection wiring 6808.

[0211] Next, the 1st sealant 6805 is formed by the dispenser etc., a spacer (not shown) is sprinkled, and the covering material 6804 is stuck. And it is filled up with a filler 6807 by the vacuum pouring-in method in the active-matrix substrate 6800 and the field which reached covering material 6804 and was surrounded by the 1st sealant 6805.

[0212] Moreover, in this example, the barium oxide is beforehand added as hygroscopic matter 6861 to the filler 6807. In addition, although the hygroscopic matter is added and used for a filler in this example, it can be made to be able to distribute massive and can also enclose into a filler. Moreover, although not illustrated, it is also possible to use the hygroscopic matter as a material of a spacer.

[0213] Next, after stiffening a filler 6807 by UV irradiation or heating, opening (not shown) formed in the 1st sealant 6805 is plugged up. If opening of the 1st sealant 6805 is plugged up, the connection wiring 6808 and FPC6809 will be electrically connected using the conductive material 6862. Furthermore, the 2nd sealant 6806 is formed so that the disclosure section of the 1st sealant 6805 and a part of FPC6809 may be covered. The 2nd sealant 6806 should just use the same material as the 1st sealant 6805.

[0214] By enclosing an EL element with a filler 6807 using the above methods, an EL element can be completely intercepted from the outside and it can protect from the exterior that the matter to which oxidization of organic materials, such as moisture and oxygen, is urged invades. Therefore, reliable EL display is producible.
[0215] (Example 10) this example shows the example at the time of changing arrangement of the direction of a light emission and light filter which are emitted from an EL element in EL display shown in the example 9. Although drawing 16 is used for explanation, since fundamental structure is the same as that of drawing 15 (B), it attaches and explains a new sign to a change portion.
[0216] The pixel section 6901 is [0217] formed in TFT6902 (henceforth TFT for EL drive) and its drain field for controlling the current which flows to an EL element of two or more pixels containing the pixel electrode 6903 grade connected electrically. In this example, n channel type TFT is used for the pixel section 6901 as TFT6902 for EL drive. Moreover, the pixel electrode 6903 is electrically connected to the drain of TFT6902 for EL drive, and this pixel electrode 6903 is formed by the electric conduction film which has shading nature. In this example, the pixel electrode 6903 turns into cathode of an EL element.
[0218] Moreover, on the luminous layer 6858 which emits light in red, and the luminous layer 6859 which emits light green, the transparent electric conduction film 6904 common to each pixel is formed. This transparent electric conduction film 6904 serves as an anode plate of an EL element.
[0219] furthermore — this example — **** — a light filter — (— R —) — 6905 — a light filter — (— G —) — 6906 — and — a light filter — (— B —) — (— not illustrating —) — covering — material — 6804 — forming — having — **** — a point — the feature — it is . Since the direction of a light emission emitted from the luminous layer goes to a covering material side when it considers as the structure of the EL element of this example, a light filter can be installed in the structure of drawing 16 , then the path of the light.
[0220] this example — like — a light filter — (— R —) — 6905 — a light filter — (— G —) — — 6906 — and — a light filter — (— B —) — (— not illustrating —) — covering — material — — 6804 — preparing — if — an active matrix — a substrate — a process — few — it can carry out — the yield — and — a throughput — improvement — it can plan — ** — saying — an advantage — it is .
[0221] (Example 11) In EL display using the drive method of this invention, the material used for EL layer which an EL element has is not limited to organic EL material, but even if it uses inorganic EL material, it can be carried out. However, since driver voltage is very high, the present inorganic EL material must use TFT which has the proof-pressure property that such driver voltage can be borne.
[0222] Or if the low inorganic EL material of driver voltage will be developed further in the future, applying to this invention is possible.
[0223] (Example 12) In EL display using the drive method of this invention, even if the organic substance used as an EL layer is a low-molecular system organic substance, it may be a polymer system (macromolecule system) organic substance. The material [organic substance / low-molecular system] consisting mainly of Alq3 (tris-8-kino rewrite-aluminum), TPD (triphenylamine derivative), etc. is known. The matter of pi conjugate polymer system is mentioned as a polymer system organic substance. Typically, PPV (polyphenylene vinylene), PVK (polyvinyl carbazole), a polycarbonate, etc. are mentioned.
[0224] A polymer system (macromolecule system) organic substance can be formed by the simple thin film formation methods, such as the spin coating method (it is also called the solution applying method), a dipping method, the dispensing method, print processes, or the ink-jet method, and its thermal resistance is high compared with a low-molecular system organic substance.
[0225] Moreover, in the EL element which EL display has, when EL layer which the EL element has has the electronic transporting bed and the electron hole transporting bed, it may constitute an electronic transporting bed and an electron hole transporting bed from amorphous semiconductors, such as an inorganic material, for example, amorphous Si, or

amorphous Si1-xCx.

[0226] A lot of interface level is formed in the interface to which a lot of trap levels exist in an amorphous semiconductor, and an amorphous semiconductor touches other layers. Therefore, an EL element can also attain high brightness-ization while being able to make it emit light on low voltage.

[0227] Moreover, a dopant (impurity) may be added in organic EL layer, and the color of luminescence of organic EL layer may be changed. As a dopant, DCM1, the Nile red, rubrene, a coumarin 6, TPB, a Quinacridone, etc. are mentioned.

[0228] (Example 13) this example explains the electronic equipment which incorporated EL display which uses the drive method of this invention as a display medium.

[0229] As such electronic equipment, a video camera, a digital camera, a head mount display (goggles type display), a game machine, car navigation, a personal computer, Personal Digital Assistants (a mobile computer, a cellular phone, or digital book), etc. are mentioned. Those examples are shown in drawing 18 .

[0230] Drawing 18 (A) is a personal computer and contains a main part 2001, a case 2002, a display 2003, and keyboard 2004 grade. EL display using the drive method of this invention can be used for the display 2003 of a personal computer.

[0231] Drawing 18 (B) is a video camera and contains a main part 2101, a display 2102, the voice input section 2103, the operation switch 2104, a dc-battery 2105, and television section 2106 grade. EL display using the drive method of this invention can be used for the display 2102 of a video camera.

[0232] Drawing 18 (C) is some head installation type (head mount display) display (right one side), and contains a main part 2301, a signal cable 2302, the head fixed band 2303, the display monitor 2304, optical system 2305, and display 2306 grade. EL display using the drive method of this invention can be used for the display 2306 of head installation type display.

[0233] Drawing 18 (D) is the picture reproducer (specifically DVD regenerative apparatus) equipped with the record medium, and contains a main part 2401, record media (CD, LD, or DVD) 2402, the operation switch 2403, a display (a) 2404, and (Display b) 2405 grade. a display -- (-- a --) -- mainly -- image information -- displaying -- a display -- (-- b --) -- mainly -- alphabetic information -- displaying -- although -- this invention -- a drive -- a method -- using -- EL -- display -- a record medium -- having had -- a picture reproducer -- a display -- (-- a --) -- 2404 -- (-- b --) -- 2405 -- it can use . In addition, this invention can be used for CD regenerative apparatus, a game machine machine, etc. as a picture reproducer equipped with the record medium.

[0234] Drawing 18 (E) is a carried type (mobile) computer, and contains a main part 2501, the camera section 2502, the television section 2503, the operation switch 2504, and display 2505 grade. EL display using the drive method of this invention can be used for the display 2505 of a carried type (mobile) computer.

[0235] As mentioned above, the scope of this invention is very wide, and applying to the electronic equipment of all fields is possible. Moreover, even if the electronic equipment of this example uses the composition which consists of combination like an example 1 - 12 throats, it is realizable.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing the drive method of the display of this invention.
[Drawing 2] Drawing showing the composition of the pixel section of the display using the drive method of this invention.
[Drawing 3] Drawing showing the composition of the pixel section of EL display.
[Drawing 4] Drawing showing the timing chart which shows the drive method of the conventional EL display.
[Drawing 5] Drawing showing the timing chart which shows the drive method of EL display.
[Drawing 6] The circuit diagram of the source signal-line drive circuit of EL display.
[Drawing 7] The plan of a latch of EL display.
[Drawing 8] Drawing showing the production process of EL display.
[Drawing 9] Drawing showing the production process of EL display.
[Drawing 10] Drawing showing the production process of EL display.
[Drawing 11] The plan and cross section of EL display.
[Drawing 12] The plan and cross section of EL display.
[Drawing 13] The cross section of the pixel section of EL display.
[Drawing 14] The cross section of the pixel section of EL display.
[Drawing 15] The plan and cross section of EL display.
[Drawing 16] The cross section of EL display.
[Drawing 17] Drawing showing the temperature characteristic of an EL element.
[Drawing 18] Drawing of electronic equipment equipped with EL display using the drive method of this invention.

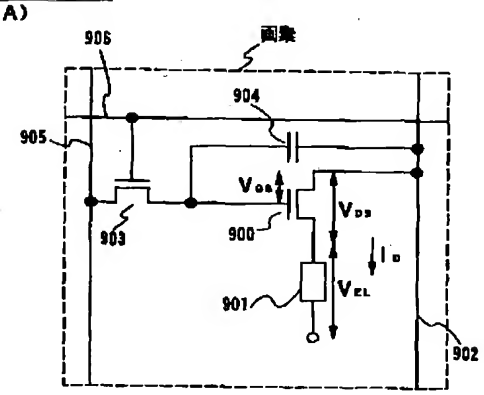
[Translation done.]

* NOTICES *

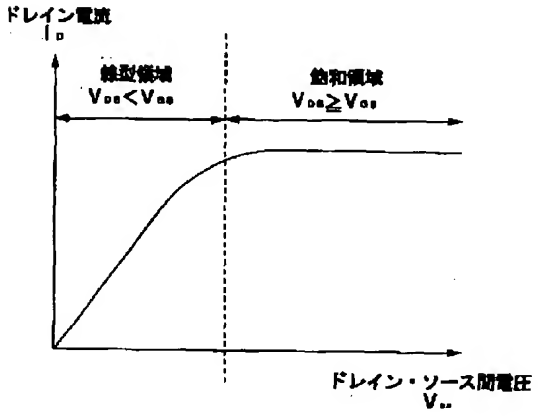
DRAWINGS

[Drawing 1]

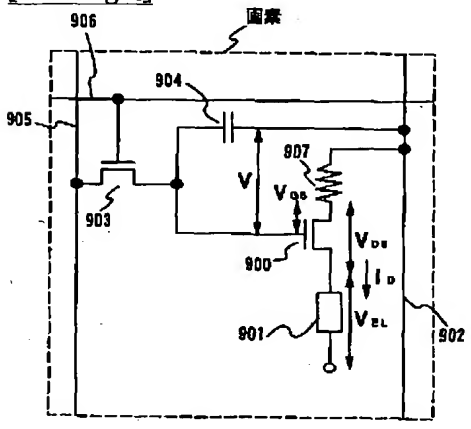
(A)



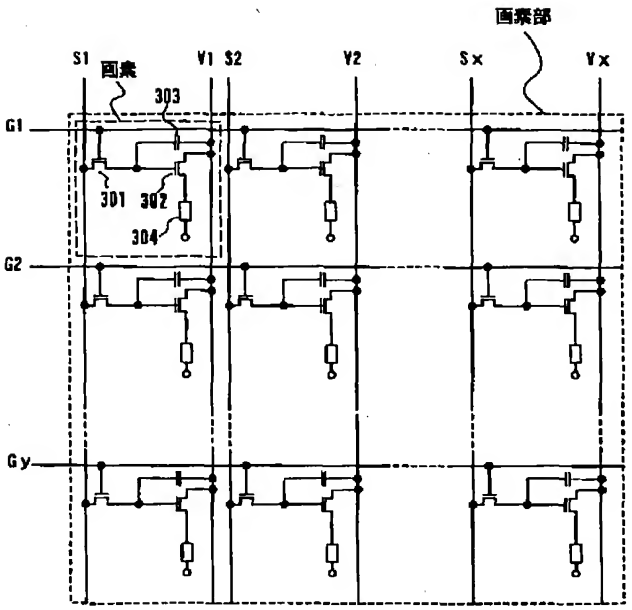
(B)



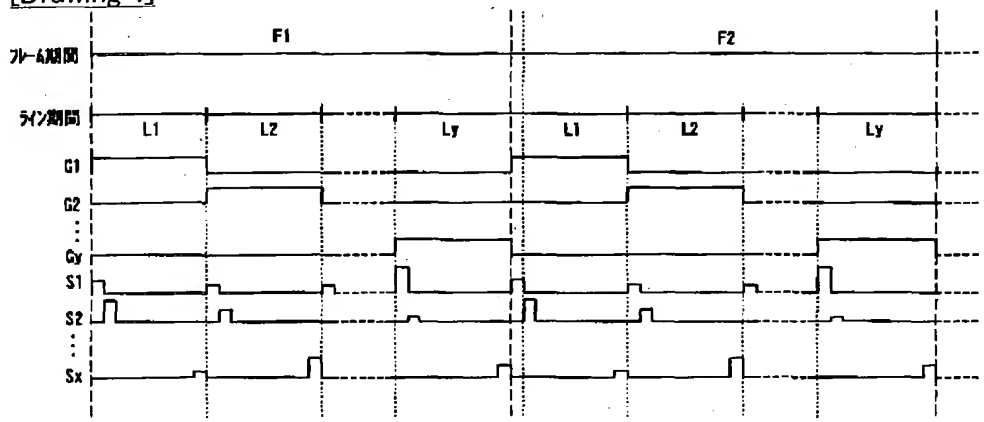
[Drawing 2]



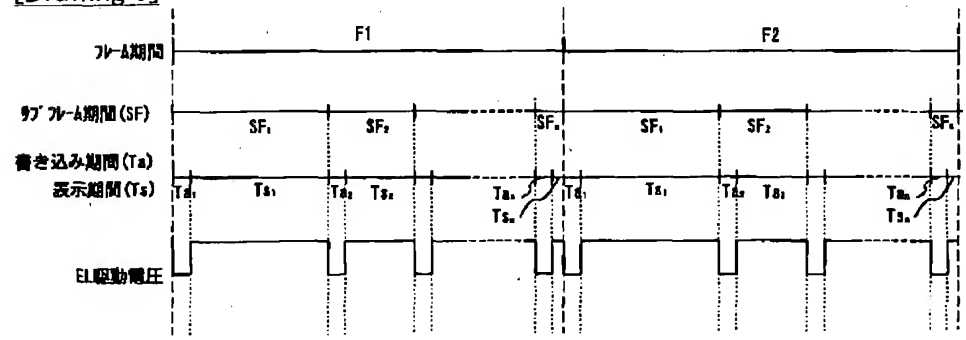
[Drawing 3]



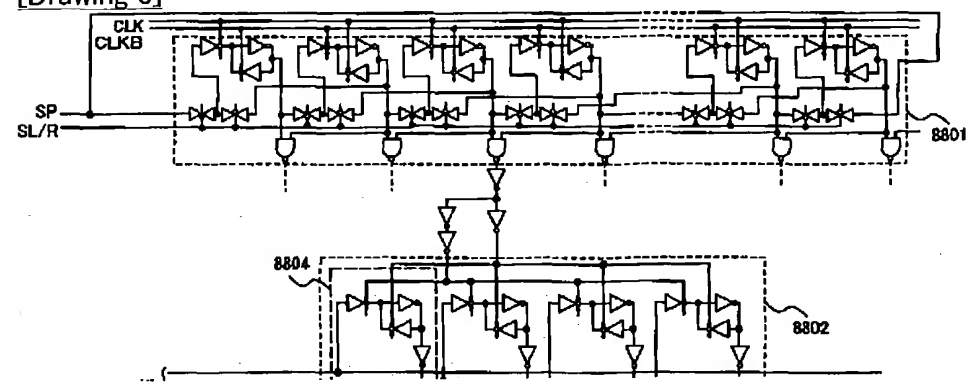
[Drawing 4]

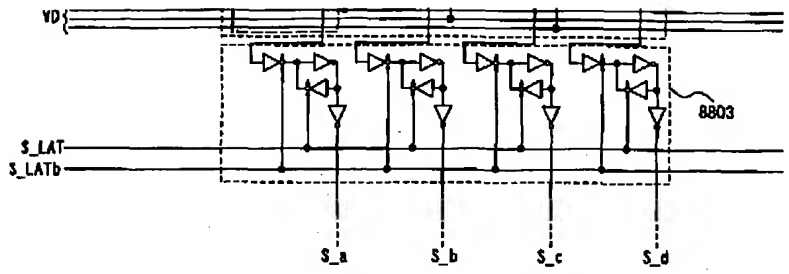


[Drawing 5]

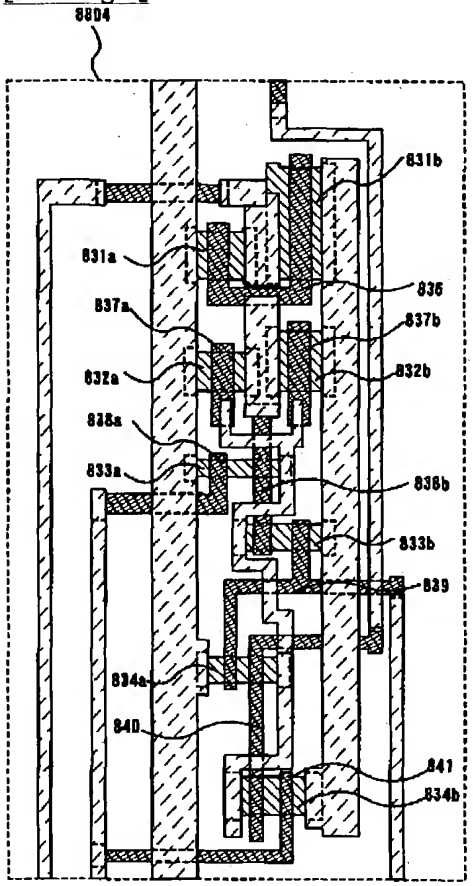


[Drawing 6]



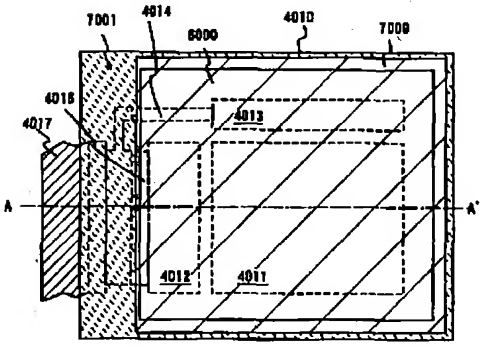


[Drawing 7]

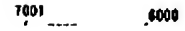


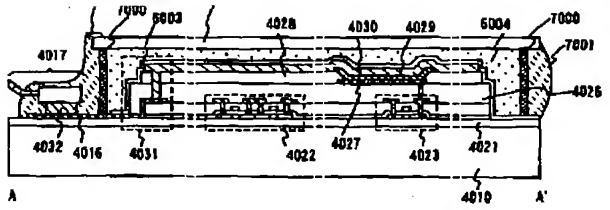
[Drawing 11]

(A)

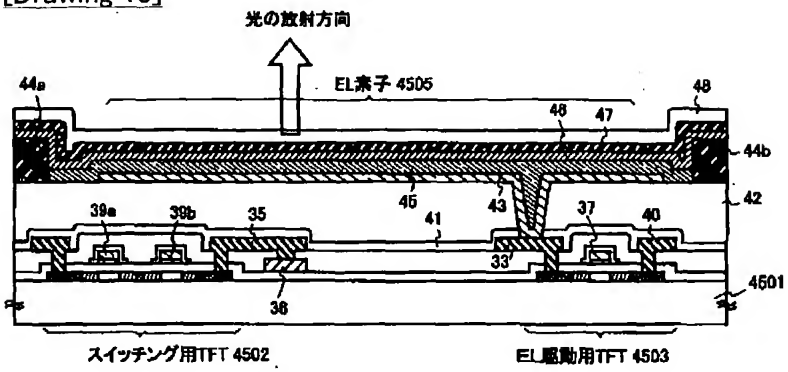


(B)

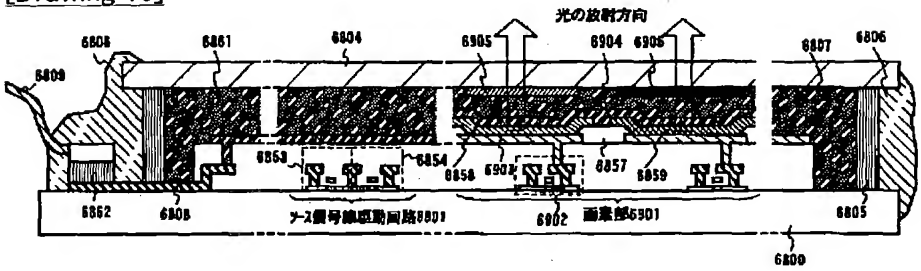




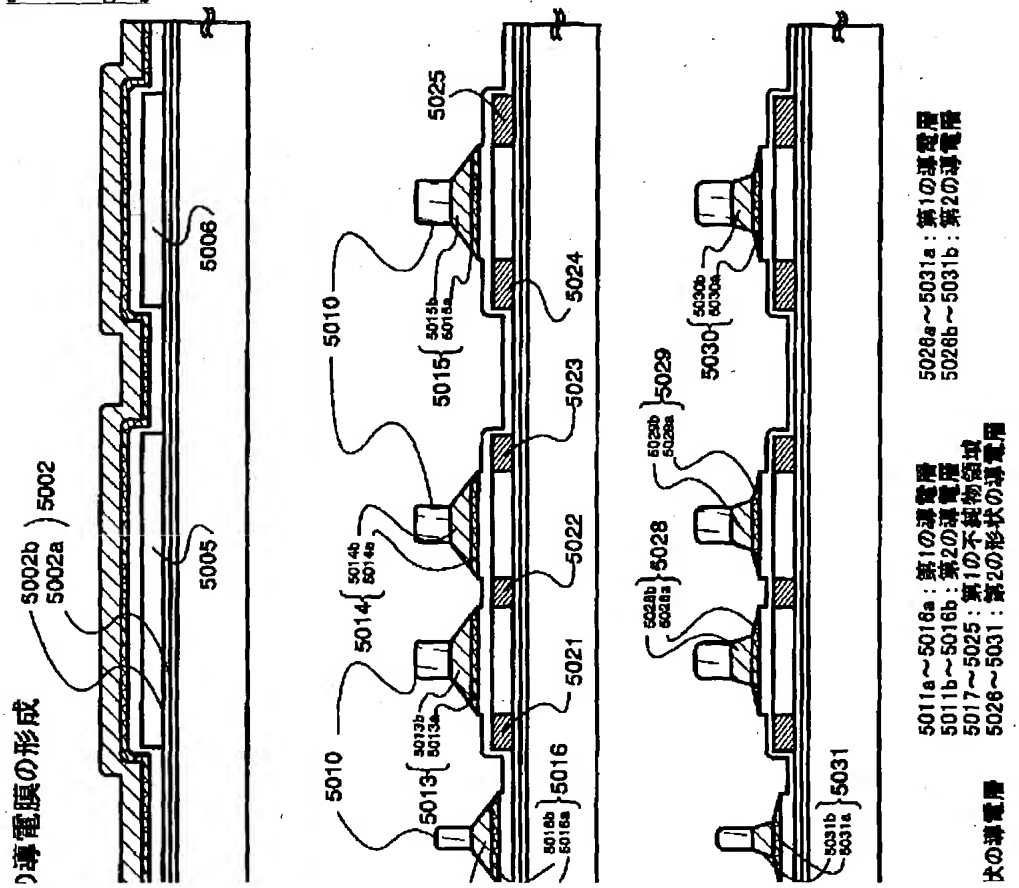
[Drawing 13]



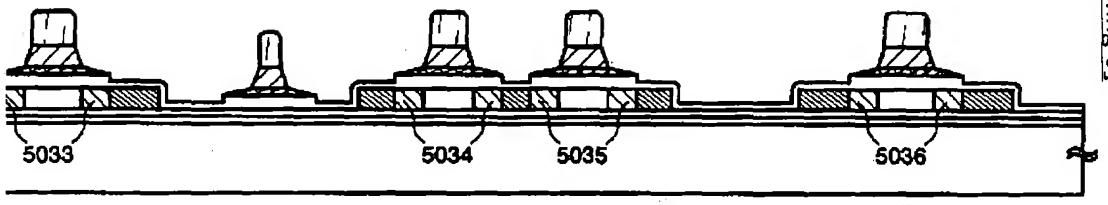
[Drawing 16]

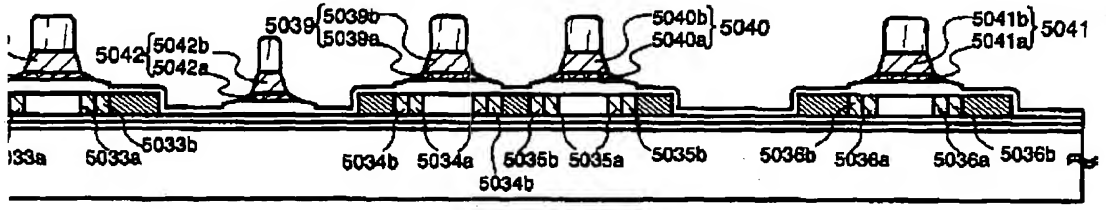


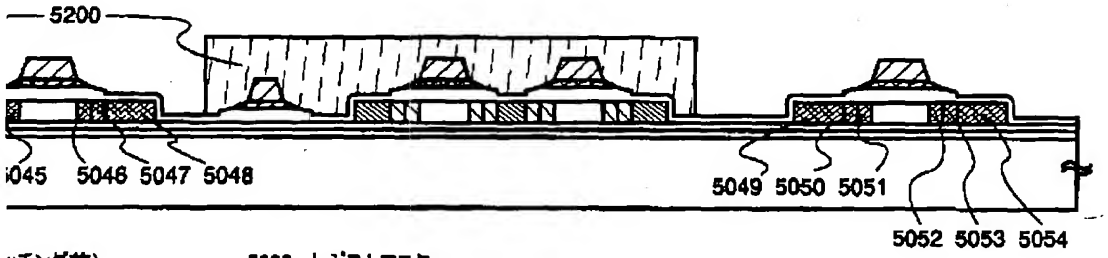
[Drawing 8]



[Drawing 9]



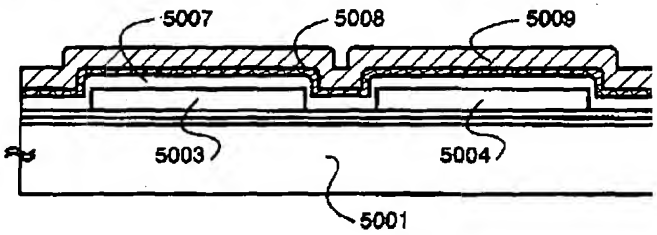




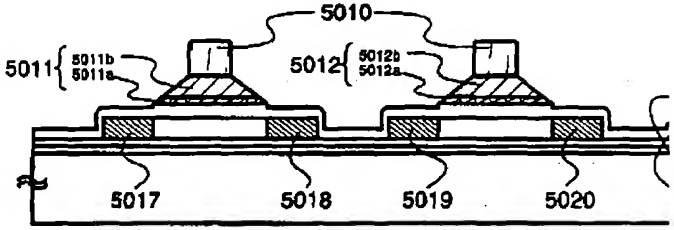
ッチング前)
ッチング後)

5200 : レジストマスク

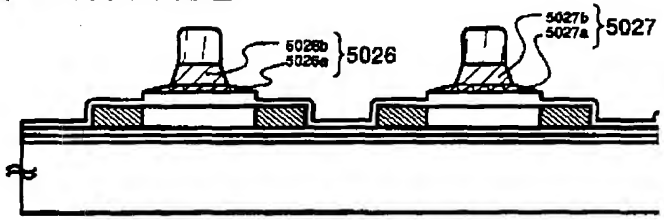
(A) 島状半導体層，ゲート絶縁膜，ゲート電極用第1・第20



(B) 第1のエッチング処理，第1のドーピング処理



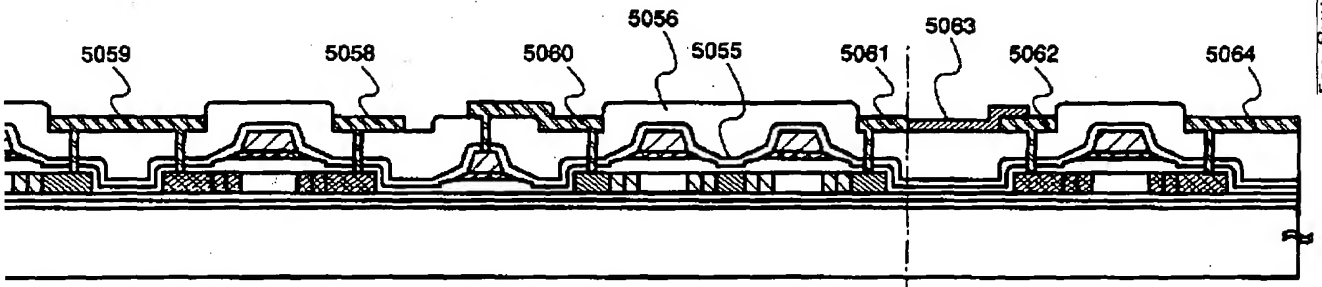
(C) 第2のエッチング処理



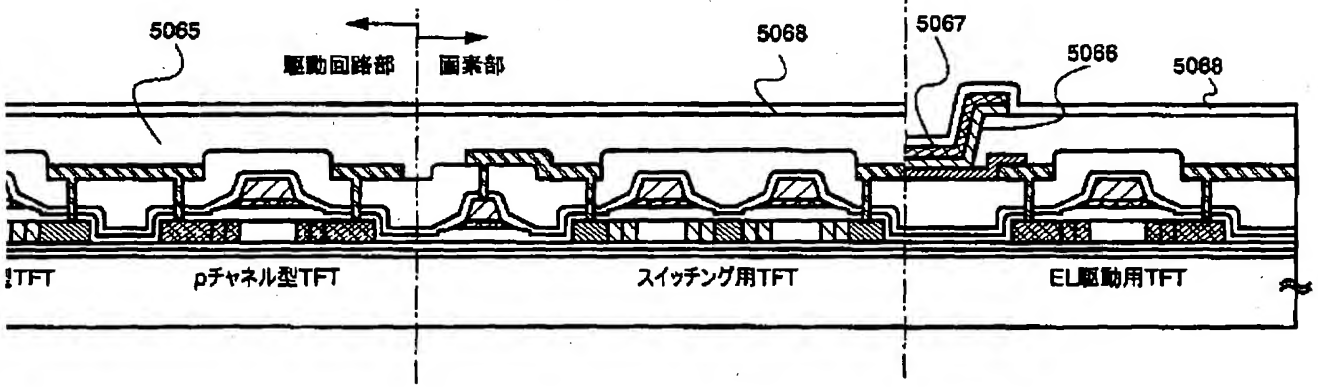
5001 : 基板
5002 : 下地膜
5003～5006 : 半導体層
5007 : ゲート絶縁膜
5008 : 第1の導電膜
5009 : 第2の導電膜
5010 : レジストマスク
5011～5016 : 第1の形

[Drawing 10]

緑膜，配線，画素電極形成

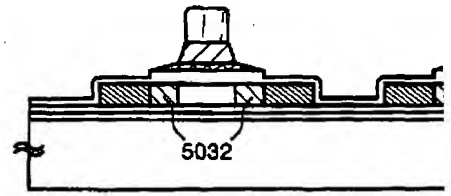


EL層，陰極電極，パッシベーション膜形成

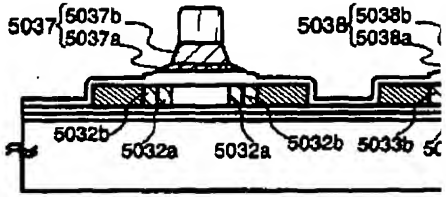


間絶縁膜　5060～5062：接続配線　5066：EL層
間絶縁膜　5063：画素電極　5067：対向電極
ソース配線　5064：電源供給線　5068：パッシベーション膜
配線　5065：第3の層間絶縁膜

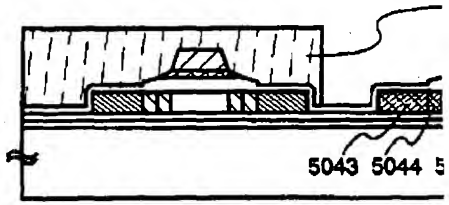
(A)　第2のドーピング処理



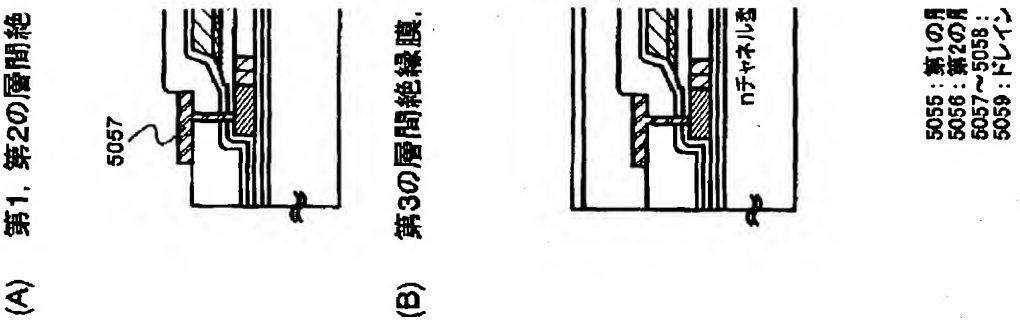
(B)　第3のエッチング処理



(C)　第3のドーピング処理

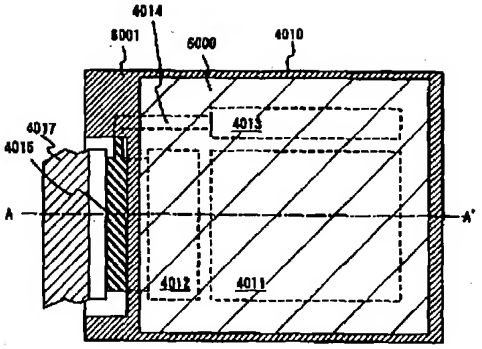


5032～5036　：第3の不純物領域(エ
5032a～5036a：第3の不純物領域(エ
5032b～5036b：第2の不純物領域
5043～5054　：第4の不純物領域

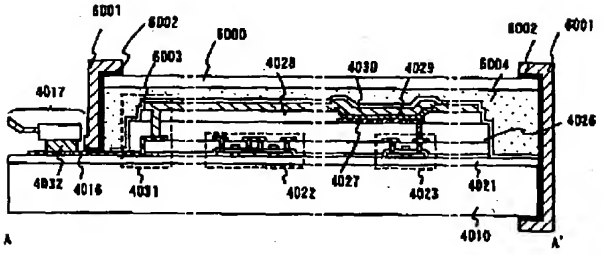


[Drawing 12]

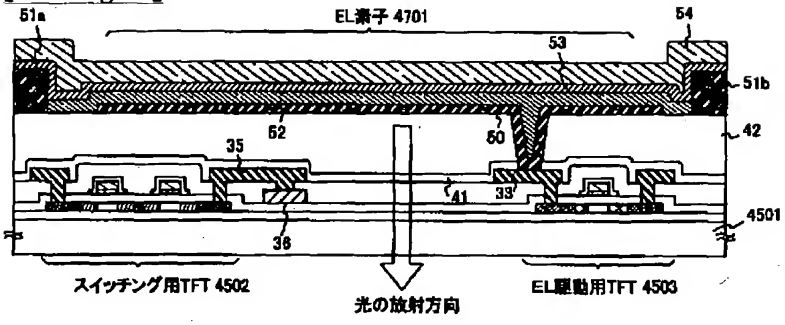
(A)



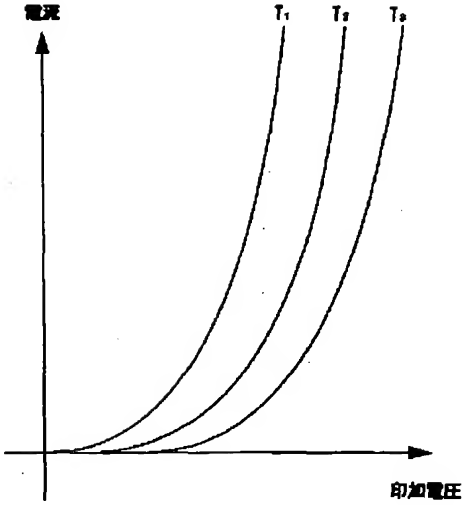
(B)



[Drawing 14]

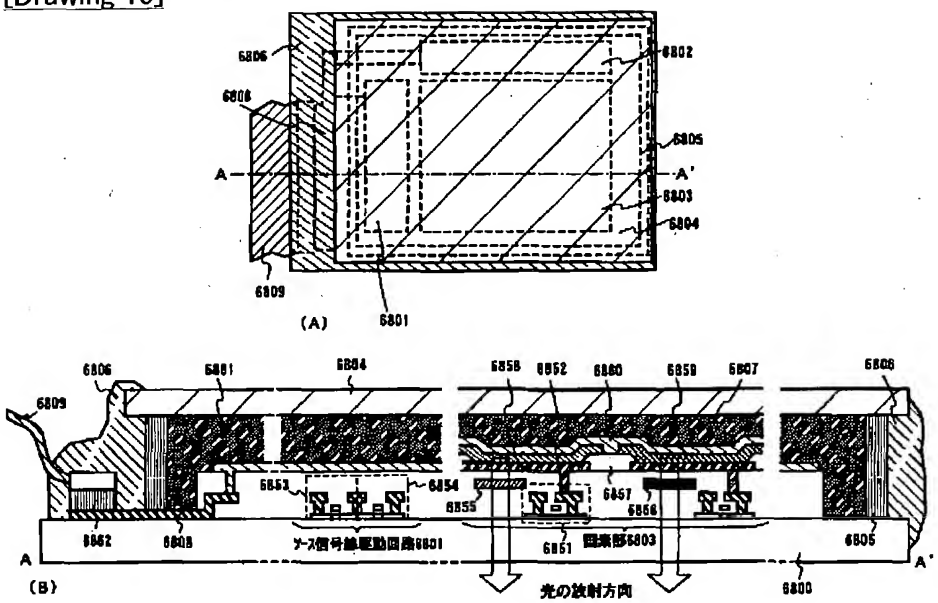


[Drawing 17]

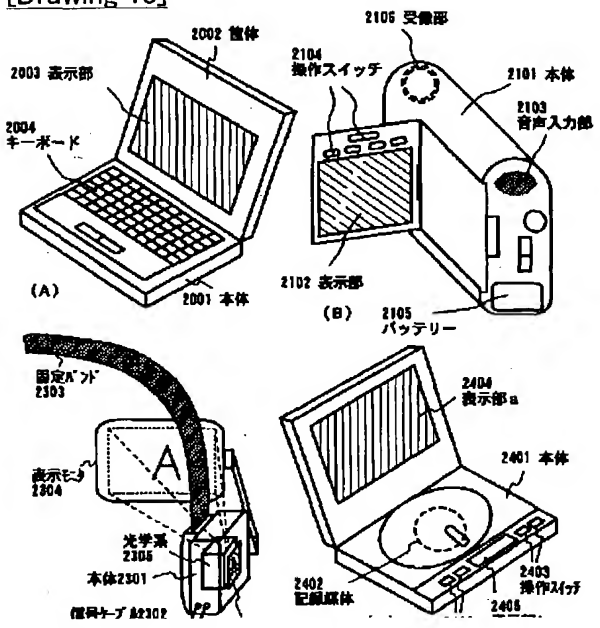


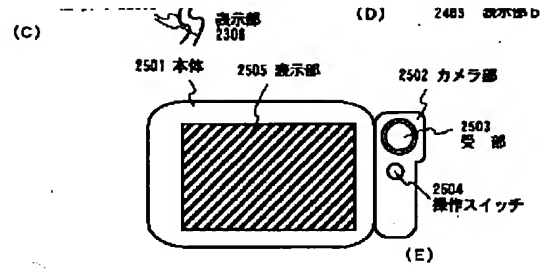
$T_1 > T_2 > T_3$

[Drawing 15]



[Drawing 18]





[Translation done.]